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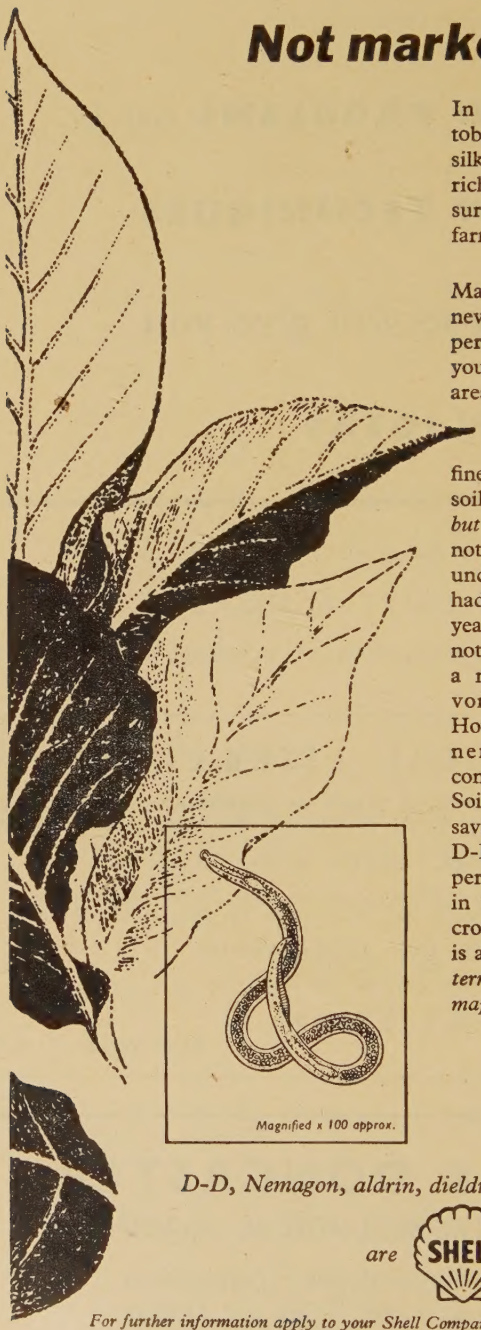


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LINSLEY (E. G.). Ed. **Evaluation of certain Acaricides and Insecticides for Effectiveness, Residues, and Influence on Crop Flavor.**—*Hilgardia* **26** no. 1, [1+] 106 pp., 3 figs., many refs. Berkeley, Cal., 1956.

Investigations were begun in California in 1951, and extended in subsequent years, on the effectiveness, the liability to cause tainting and the toxic residues involved in the use of organic acaricides in sprays on certain orchard fruits and insecticides applied to the soil in which root crops are grown. The results are here presented in a series of reports, comprising: **Field Tests of Acaricides for Control of Mites on Pears and Apples,** by H. F. MADSEN & A. D. BORDEN (pp. 7–18, 9 refs.); **Field Tests of Acaricides for Control of Spider Mites on Almonds and Peaches,** by F. M. SUMMERS (pp. 19–34, 6 refs.); **Effects of Acaricides on Flavor of Almonds and canned Fruits,** by E. HINREINER & M. SIMONE (pp. 35–45, 15 refs.); **Harvest Residues of Acaricides used on deciduous Fruits,** by R. P. MISKUS, W. R. ERWIN & W. M. HOSKINS (pp. 46–59, 14 refs.); **Residual Soil Insecticides for the Control of Wireworms affecting Vegetable Crops,** by W. H. LANGE & E. C. CARLSON (pp. 60–75, 3 figs., 28 refs.); **Effects of Soil Insecticides on Flavor of Vegetable Crops,** by HINREINER & SIMONE (pp. 76–85, 30 refs.); and **Harvest Residues of Insecticides in Vegetable and Field Crops resulting from Foliage and Soil Application,** by ERWIN, MISKUS & HOSKINS (pp. 86–106, 12 refs.), and they are summarised by the editor in his introduction (pp. 1–6, 5 refs.), on which the following is based.

Aramite (2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite) gave consistently good results against *Tetranychus telarius* (L.) (*bimaculatus* Harvey) on apple, pear and peach and against *T. pacificus* McG. on almond, and variable, but generally adequate, results against *Panonychus* (*Metatetranychus*) *ulmi* (Koch) on apple and pear; residues were less than 0·1 part per million in fresh pears and in canned pears, peaches and apple sauce, but the flavour of canned pears and peaches was affected after 2·5–11 and 1·5–7·5 months, respectively. Chlorobenzilate [ethyl 4,4′-dichlorobenzilate], Genite-876 (bis(p-chlorophenyl)-ethynylcarbinol) and Dimite (1,1-bis(p-chlorophenyl)ethanol) showed promise against these mites, with low residues and no effect on flavour in canned pears and peaches. Apple sauce prepared from apples sprayed with Chlorobenzilate developed a marked change in flavour after six months, probably owing to the slow formation of a degradation product, since only 0·3 p.p.m. residue was found; there was some evidence of a similar result with Genite-876 on peach and Dimite on pear. Genite-923 (2,4-dichlorophenyl benzenesulphonate) was very effective against *P. ulmi*, and effective against *T. telarius*, on pear and gave excellent control of *Bryobia praetiosa* Koch when applied to peach and almond in pre- or post-bloom sprays, but was not effective against *T. telarius* on peach or *T. pacificus* on almond. It left low residues, but affected the flavour of canned pears in 1952, though not in 1953, and caused marked changes in the flavour of canned apple sauce and peaches, probably owing to the production of a degradation product; pre-bloom applications did not affect the flavour of canned pears or peaches. In general, Ovotran (p-chlorophenyl p-chlorobenzenesulphonate) gave excellent control of *T. telarius* and *P. ulmi* on apple and pear; on peach and almond it gave good control of *B. praetiosa* in pink-bud and petal-fall sprays and prevented increases in *T. telarius* and *T. pacificus*. Residues were low and flavour unaffected, except in canned pears in 1952. Sulphenone [p-chlorophenyl phenyl sulphone] gave variable control in 1950–52, but was satisfactory against *P. ulmi* and *T. telarius* on apple and pear in 1953 and 1954 and against *T. telarius* on peach in 1953. Flavours were unaffected in 1953, but that of pears was impaired in 1952. Malathion gave moderate to good initial control of *T. pacificus* on almond, *T. telarius* on peach, pear and apple, and *P. ulmi* on apple, but diminished

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noticeably in effect in 2–3 weeks; it left low residues and had little effect on flavour except on canned pears in 1952, after storage for 11 months. Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate] was tested against the same three species and gave promising results, though it appeared to have less residual effect than some other materials, and Systox [diethyl 2-(ethylthio)ethyl phosphorothioate (demeton)], applied at high rates of 0·75–1 pint 23 per cent. emulsion concentrate per 100 gals., gave excellent control of all three in preliminary tests on the various fruits. Residues were not a problem. In single tests, schradan gave excellent control of *P. ulmi* on pear, but was not effective against *T. pacificus* on almond when applied in mid-season; pears showed a fairly high residue before canning in 1953 but there was no off-flavour in the canned product in 1954.

Tests over several years showed that *Limonius canus* (Lec.) and related wireworms can be effectively controlled under most conditions by soil applications of 2–5 lb. aldrin, heptachlor, dieldrin or endrin, 5–10 lb. chlordane or 10–40 lb. DDT per acre, without measurably injuring or affecting the flavour of carrots, potatoes or sweet potatoes. Isodrin gave good control at 2–5 lb. per acre, but left slight residues in canned carrots and sweet potatoes in 1953 and affected their flavour three months after canning; fresh sweet potatoes had an undesirable flavour in 1954, though no residual isodrin was found, and this compound should be used cautiously until more is known about it. BHC and lindane (almost pure γ BHC) were effective at 0·5–1 lb. γ isomer per acre, but analysis for organic chlorine and bioassay tests [*cf. R.A.E.*, A **41** 70] showed comparatively high residues in fresh carrots; bioassay revealed no residues of BHC in canned carrots and sweet potatoes or of lindane in these and canned potatoes, but all were affected in taste, and these compounds should therefore not usually be applied to the soil less than two years before root vegetables are grown. All these insecticides gave control for one or several years but differed considerably in speed of action, DDT failing to protect potatoes adequately when applied about a month before planting, whereas γ BHC acted more rapidly. More BHC was required in heavy clay than in lighter soils, but the other compounds gave equally good control in either at first, though effectiveness soon diminished in certain soils containing much colloidal clay; in these, greatly increased dosages may be necessary.

Moreton (B. D.). **Beneficial Insects.**—*Bull. Minist. Agric.* no. 20 (5th edn.), vi + 49 pp., 4 col. pls., 53 refs. London, H.M.S.O., 1958. Price 5*s.* 6*d.*

The text of this fifth edition of a bulletin on beneficial insects, with special reference to those found in Britain, resembles the earlier one in general scope [*cf. R.A.E.*, A **27** 436], but has been rewritten to include matter on other organisms and to bring the information up to date. It contains notes on the bionomics and habits of the various insect groups that include predators and parasites and on predacious mites, and work on some of the species, principally predators of orchard pests in Britain, is reviewed in some detail from the literature. A brief section is devoted to the effects of some fungus, bacterial and virus diseases that attack insects and the use that has been made of them in control, and, in other sections, research on the effects of recently developed insecticides on predators, parasites and pollinating insects and of the destruction of natural enemies on pest populations, on the development of spray programmes that are relatively harmless to beneficial species, and on the artificial distribution of beneficial insects for the control of insect pests and weeds in Britain and elsewhere is reviewed.

D'Aguilar (J.), Biliotti (E.) & Targe (A.). **Sur la présence et les dégâts de** *Pseudonapomyza dianthicola* **Vent. dans les Alpes-Maritimes (Dipt. Agromyzidae).**—*Bull. Soc. ent. Fr.* **62** no. 1–2 pp. 11–13, 2 refs. Paris, 1957.

*Pseudonapomyza dianthicola* Venturi was found mining the leaves of carnation near Nice in 1953. It had apparently been present in the area for some time, and infestation was observed in subsequent years in other localities in the district. The bionomics of this Agromyzid are reviewed, mostly from the literature [*cf. R.A.E.*, A **41** 107]. Parasitism was high [*cf.* **41** 107; **42** 111]; *Solenotus isaea* (Wlk.), which was the most important parasite, and another Eulophid, probably *Achrysocharis formosa* (Westw.), were reared from the larvae, and a species thought to be *Halticoptera patellana* (Dalm.) from the puparia. The Agromyzid might have been introduced with planting material or cut flowers from Italy, but probably spread naturally from the Genoa region.

Labeyrie (V.). **Sur l'attractivité de diverses alliacées vis-à-vis de la mouche de l'oignon:** *Hylemyia antiqua* **Meigen (Dipt. Muscidae).**—*Bull. Soc. ent. Fr.* **62** no. 1–2 pp. 13–15, 1 graph, 4 refs. Paris, 1957.

Although the use of resistant varieties has been suggested as a means of reducing the damage caused by *Hylemyia antiqua* (Mg.) to onion and related plants, it was not certain whether the differences in infestation observed were not due to variations in larval development on different parts of the plants, though they generally feed at the base, or to preference for plants in a particular stage of development. In investigations in south-western France, mortality and pupal weight were the same, whether the insects fed on the aerial parts of the plants or the bulbs, and, on onion, 56·1, 19·6, 22·7 and 1·6 per cent. of the eggs were laid in the leaf axils, between the bulb scales, on the soil and on the leaves, respectively, showing that the females oviposit mainly in interstices on the plants. Counts of eggs laid on shallot, onion and leek from 26th April to 25th July showed that the period of maximum oviposition coincided with the period of greatest vegetative development of the particular crop. Since the three plant species reached this stage at different times of the year, their relative attraction for *H. antiqua* did not remain constant, and most of the eggs were laid on shallot in late April and May, on onion in the first half of June, and on leek in July. Among plants of the same variety and the same stage of development, those already injured mechanically or by previous infestation are the most damaged, and it is concluded that the ovipositing adults are attracted by the odour of leaves, which is enhanced by wounds or decay.

Jourdheuil (P.). **Description d'un ichneumonide (Mesochorini) parasite secondaire de diverses espèces de** *Phyllotreta* **(Hym. Ichneumonidae).**—*Bull. Soc. ent. Fr.* **62** no. 1–2 pp. 41–45, 3 figs., 9 refs. Paris, 1957.

*Mesochorus phyllotretae*, sp.n., is described from adults of both sexes reared from adults of several species of *Phyllotreta* attacking crucifers near Versailles. Dissections showed that it is a secondary parasite, its primary hosts being the larvae of *Microctonus*, which are internal parasites of the flea-beetles.

Plichet (F.). **La cochenille du noyer en Dordogne.**—*Rev. Zool. agric.* **56** no. 1–3 pp. 14–18, 2 maps. Talence, 1957.

An outbreak of *Eulecanium corni* (Bch.) on walnut in the department of Dordogne, in south-western France, began in 1952. The Coccid, which

occurs in large numbers only occasionally, was evidently favoured by the damp atmosphere and shelter from northerly winds provided by the valleys, and subsequently spread considerably, but the use of control measures, especially during the winter of 1954–55, the occurrence of unusually cold weather in February 1956 and the effect of natural enemies, led to a slight reduction in infestation in that year. The principal natural enemies were an Anthribid, apparently *Anthribus nebulosus* Forst. [*cf. R.A.E.*, A **17** 338], and an oribatid mite. Females of the Anthribid oviposit in spring at the same time as *E. corni*, laying one egg beneath each scale. The larva feeds on the eggs and gives rise to an adult in June. This feeds on the eggs beneath other scales and overwinters from the time the crawlers hatch until the following spring. The mite, of which several adults usually attack one host, occurs beneath the scales at the time of oviposition and hatching of *E. corni*. The control afforded by these enemies was insufficient, however, especially as the females of *E. corni* produce up to 5,000 or more eggs each. Spraying in summer, when the crawlers are present on the lower surfaces of the leaves, is preferable to winter treatments, which are expensive and may injure vegetation beneath the trees. Treatment against the crawlers dispersing over the leaves was successfully applied in 1955, and over 99 per cent. control was obtained in 1956 in a heavily infested area when emulsion concentrates containing 78 per cent. white oil and 3 per cent. parathion or 63 per cent. oil and 9 per cent. malathion were applied at 0·5 per cent. and one containing 53 per cent. oil and 10 per cent. malathion was applied at 0·75 per cent. towards mid-July, as compared with a natural mortality of 1·7 per cent. for no treatment.

Blankwaardt (H. F. H.). **De populierenscheutboorder** (*Epinotia* (*Gypsonoma*) *aceriana* **Dup.).** [The Poplar Shoot Borer (*G. aceriana*).]—*Meded. Inst. toegep. biol. Onderz. Nat.* no. 22, 6 pp., 2 pls., 3 figs., 2 refs. Arnhem, 1955. (With a Summary in English.)

*Gypsonoma* (*Epinotia*) *aceriana* (Dup.) caused serious damage to poplar in a nursery in Holland in 1950–51. Its bionomics and control were investigated, and the following is based partly on the author's summary of the results. The adults of this Tortricid emerge in June–July. The eggs are laid singly at the base of the buds in the axils of the petioles, and the larvae are present in August, mining in the tips of the shoots and later in the petioles and veins of the leaves. They leave the mines in October and overwinter in or near the buds lower down the shoots. Feeding is resumed in early spring, and the larvae then destroy many buds and tunnel in the pith of young shoots, rendering them unsuitable for use as cuttings. Pupation takes place in May, at the entrance to the mine. The bundles of cuttings are always submerged for two hours in bordeaux mixture, which should prevent the spread of the pest. In a test, complete control was given by a DDT spray applied to the shoots about mid-May.

Loosjes (F. E.). **Ervaringen met** *Chaetospila elegans* (**Westw.**) **(Hymenoptera, Pteromalidae), een parasiet van enige soorten voorraadinsecten.** [Experiments with *C. elegans*, a Parasite of certain Species of Stored-product Insects.]—*Ent. Ber.* **17** no. 4 pp. 74–76, 3 refs. Amsterdam, 1957. (With a Summary in English.)

During the laboratory rearing of stored-product pests for tests of insecticides in Holland, parasitism by *Chaetospila elegans* Westw. caused considerable losses of *Calandra granaria* (L.). The Pteromalid also parasitised *Acanthoscelides obtectus* (Say), but was of little importance in cultures of

the latter. In tests, the parasite appeared to give better control of *C. granaria* in wheat than did dusts of pyrethrum with piperonyl butoxide, and it was able to survive the winter in wheat stored indoors in which the temperature fell to −3·5°C. [25·7°F.].

KABACHNIK (M. I.) & others. **Organophosphorus Insecticides. O,O-Diethyl-β-ethylmercaptoethyldithiophosphate (M-74) and its Analogues.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* **109** no. 4 pp. 777–780, 11 refs. Moscow, 1956.

The authors discuss the synthesis of O,O-dialkyl S-2-(alkylthio)ethyl or S-2-(alkoxyalkylthio)ethyl phosphorodithioates, which possess insecticidal and acaricidal properties, and give the results of tests with O,O-diethyl S-2-(ethylthio)ethyl phosphorodithioate (M-74), the best of them. It was used in the form of an emulsion concentrate containing 30 per cent. active ingredient and 70 per cent. adjuvant and compared with parathion (tiofos) for contact toxicity and with demeton (mercaptofos [diethyl 2-(ethylthio)-ethyl phosphorothioate]) for systemic effect.

In dips at 0·0005 per cent., M-74 gave complete mortality of adult females of *Eurygaster integriceps* Put., as compared with only 84·4 per cent. for parathion, and when older nymphs and adults of *Pseudococcus maritimus* (Ehrh.) were treated with 0·005 per cent. sprays, the percentage dead and paralysed was 98·5 for M-74 and 72·7 for parathion. In 0·05 per cent. sprays applied to greenhouse plants, both compounds gave over 90 per cent. kill of *Coccus hesperidum* L. in 20 days, and a direct spray of 0·0025 per cent. of either gave practically complete mortality of *Myzus* (*Myzodes*) *persicae* (Sulz.).

The systemic effect was tested by means of sprays applied to apple and small plum trees in the orchard and roses in the greenhouse, and treatment of seeds. Sprays of 0·05 per cent. M-74 or demeton applied to apples when the population of *Panonychus* (*Metatetranychus*) *ulmi* (Koch) was increasing rapidly caused 94·6 per cent. reduction in numbers after 36 days, as compared with a tenfold increase on unsprayed trees, and the same treatments almost completely freed the plum trees from *Hyalopterus pruni* (Geoffr.) for 27 days. At 0·08 per cent., M-74 remained effective against *Tetranychus* sp. on rose for more than 1·5 months. When wheat seed was treated with 0·2 per cent. M-74, the 17-day-old shoots gave complete kill of nymphs of *Calliptamus italicus* (L.) and adults of *E. integriceps* that fed on them, and in field tests, in which wheat seed was treated with 0·45–0·6 per cent. solutions of M-74, 84–96·7 per cent. mortality and occasionally complete kill of *E. integriceps* was subsequently observed.

KABACHNIK (M. I.) & others. **Organophosphorus Insecticides. Some Analogues of O,O-Diethyl-β-ethylmercaptoethyldithiophosphate (M-74) less toxic to warm-blooded Animals.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* **109** no. 5 pp. 947–949, 3 refs. Moscow, 1956.

Since O,O-diethyl S-2-(ethylthio)ethyl phosphorodithioate (M-74), which was shown to possess outstanding acaricidal and insecticidal properties [*cf.* preceding abstract], proved highly toxic to mammals, the LD100 by internal administration to rabbits being 3–3·5 mg. per kg. body weight, four analogues of it were prepared and tested in emulsion form as before. These were O,O-diethyl S-2-(methylthio)ethyl phosphorodithioate (M-80), O,O-dimethyl S-2-(ethylthio)ethyl phosphorodithioate (M-81), O,O-dimethyl S-2-(methyl-thio)ethyl phosphorodithioate (M-82) and O,O-diethyl S-2-(propylthio)ethyl phosphorodithioate (M-85). Their LD100's for rabbits were 5–5·5, 20, 22–25

and 5 mg. per kg., respectively, as compared with 7·5 mg. for parathion. Their contact toxicity to insects was tested in the laboratory by spraying older nymphs of *Pseudococcus maritimus* (Ehrh.) and by dipping adults of *Eurygaster integriceps* Put. for five seconds, and the percentage concentrations that gave 95–100 per cent. kill of *Pseudococcus* and (in brackets) *Eurygaster* in seven days were 0·01 (less than 0·005) for M-80, 0·025 (more than 0·0005) for M-81, 0·015 (more than 0·0005) for M-82, and 0·05 (0·05) for M-85, as compared with 0·005 (0·0005) for M-74 and more than 0·025 (0·005) for parathion. Their systemic effect was investigated by wetting wheat seed with 0·6 per cent. dilutions of the chemicals, drying, sowing in pots, and allowing *E. integriceps* to feed on the shoots that had developed 7–10 days later. After a week, the mortality percentages were 80 for M-80, 82·5 for M-81, 87·5 for M-82 and 25 for M-85, as compared with 85 for M-74 and 60 for demeton (mercaptofos [diethyl 2-(ethylthio)ethyl phosphorothioate]). In greenhouse tests against *Tetranychus* sp. on ornamental plants, M-74, M-82 and demeton at 0·025 per cent. were about equally effective, giving 99·2, 97·7 and 96·7 per cent. reduction in population after 15 days. M-80 gave only 93·2 per cent. reduction.

Attention is drawn to the low insecticidal effectiveness of M-85, which was about as toxic to rabbits as M-74 and M-80, and the good systemic properties of M-81 and M-82, which were much the least toxic to rabbits. It is concluded that some analogues of M-74 are less dangerous to mammals while retaining good toxicity to insects and mites, and are thus more promising for practical use.

Polivanova (E. N.). **Factors affecting the Abundance of Cereal Bugs (Pentatomidae) in the southern Grain-growing Regions of the European Part of the Soviet Union.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* **112** no. 3 pp. 538–541, 7 refs. Moscow, 1957.

*Eurygaster integriceps* Put. is the most abundant of the Pentatomids that feed on cereals in the south of European Russia and is much more important than *Dolycoris baccarum* (L.), *Aelia rostrata* Boh., *A. acuminata* (L.), *Carpocoris pudicus* (Poda), or *C. p. fuscispinus* (Boh.). It came originally from western Asia, and its life-cycle is similar to that of desert insects [*cf. R.A.E.*, A **35** 345]. It finds favourable conditions for development in regions in which winter wheat is grown, and as oviposition by it begins early, about 20th May, and its eggs develop rapidly, they largely escape parasitism by *Telenomus* spp., which are most numerous later in the season (June–July). This is of importance, because the individuals that hatch from eggs deposited early appear to be the most prolific. Investigations in the district of Voroshilovgrad (eastern Ukraine) in 1955 showed that the parasitism percentages were 8 at the end of May, 48·8 and 82·1 at the beginning and end of June and 88·3 in early July, when the wheat is harvested and the adults of *E. integriceps* migrate to their aestivation quarters. The other Pentatomids are of western Mediterranean origin and differ from *E. integriceps* in having a long active life without summer diapause and in giving rise to two generations a year, of which the eggs are deposited in May–July and between the end of July and the end of September or early October and develop more slowly than do those of *E. integriceps*. The eggs of *D. baccarum*, *C. p. fuscispinus* and *Aelia* showed low rates of parasitism in May–June, but the attack increased rapidly in July and reached 89·5, 87 and 83·9 per cent., respectively, in August, so that the overwintering population was much reduced. Eggs of *D. baccarum* sometimes show 100 per cent. parasitism. Furthermore, the first-instar nymphs are attacked by Chrysopid larvae and the older nymphs and adults

by parasites (Phasiines, Strepsiptera and Mermithids). The percentage parasitism in 1955 was 22·2 at the end of May, 10–19·1 in June, 25–37·9 in July, and 52·5 in August. Conditions are less favourable for these species than for *E. integriceps*, as the wheat fields offer unfavourable feeding sites in the second half of summer, after the harvest.

Tomašević (B.). *Carpoglyphus lactis* **L. na suvim šljivama.** [*C. lactis* on dried Prunes.]—*Plant Prot.* no. 33 pp. 57–65, 4 figs., 3 refs. Belgrade, 1956. (With a Summary in English.)

Dried prunes stored in northern Bosnia in 1954–55 were found to be infested by a mite identified from the description given by Hughes [*R.A.E.*, A **37** 7] as *Carpoglyphus lactis* (L.). Investigations showed that development of this mite was completed in 16–23 days at 22°C. [71·6°F.]. Relative humidity was important, 75 per cent. being the most favourable and 50 per cent. checking development. The adults died in 5–6 days at −11°C. [12·2°F.], but the larvae survived for six weeks. Exposure to 80°C. [176°F.] killed all the mites in 15 minutes. Fumigation with sulphur dioxide at 10, 20 and 30 oz. per 1,000 cu. ft. for 0·75, 2·45 and 1 hour, respectively, at temperatures of 15–26°C. [59–78·8°F.] gave complete or virtually complete mortality of mites on the surface of the prunes but not of those inside, so that the measure should be repeated after a few days.

Diklić (V.). **Uticaj niskih temperatura na stadium eonimfe obične borove zolje.** [Effect of low Temperatures on the Eonymphs of *Diprion pini*.] —*Plant Prot.* no. 34 pp. 57–62, 5 refs. Belgrade, 1956. (With a Summary in French.)

Experiments in Yugoslavia showed that the eonymphs of *Diprion pini* (L.) were little affected by exposure to 0°C. [32°F.], even for 60 days, or to −5°C. [23°F.] for five days, though exposure to the latter for 6–10 days resulted in increased mortality. Mortality was considerably increased by exposure to −10°C. [14°F.], with little relation to its duration (1–15 days), and this temperature killed all examples removed from their cocoons. At −20°C. [−4°F.], exposure for periods ranging from 5 hours to 10 days resulted in mortality increasing with length of exposure.

Stojanović (D.). **Jabučni svrdlaš kao prenosilac konidija** *Monilia* **spp. (Prethodno saopštenje.)** [*Rhynchites bacchus* as a Vector of the Conidia of *Monilia* spp. (Preliminary Communication.)]—*Plant Prot.* no. 34 pp. 63–65, 2 figs. Belgrade, 1956. (With a Summary in English.)

Investigations in Yugoslavia in 1953–55 showed that 74 per cent. of the adults of *Rhynchites bacchus* (L.) taken on fruit trees bore conidia of *Monilia* spp. on their bodies, particularly on the legs and lower parts of the abdomen. As these weevils feed on fruits, they doubtless play an important part in the spread of the fungi.

Lekić (M.). **O jednoj štetnoj vrsti iz roda** *Agrilus* **šljivin prstenar** *Agrilus macroderus* **Ab.** [*A. macroderus* as a Pest of Fruit-tree Nurseries.]—*Plant Prot.* no. 35 pp. 3–22, 4 pls., 2 figs., 2 graphs, 9 refs. Belgrade, 1956. (With a Summary in German.)

*Agrilus macroderus* Ab. is very injurious in fruit-tree nurseries in Serbia, and observations on its food-plants and bionomics were carried out in 1949–50

and 1953–55. They showed that stone fruits were preferred to pip fruits and that only first- and second-year stock was infested. The adults emerged in the second half of June and congregated on the sunny sides of the trees. Pairing and oviposition occurred at temperatures of 20–25°C. [68–77°F.], after a period of maturation feeding lasting about a week. The eggs were laid on the trunks, about 4 ins. above the collar, and covered with an adhesive. The larvae hatched in 5–8 days at 20–25°C. and 65–80 per cent. relative humidity, penetrated directly into the trunk, which they ringed, and then bored up, or occasionally down, the heartwood. The parts above the ring dried up. Most of the larvae became full-fed by October, and they pupated in spring, as soon as the temperature reached 16–17°C. [60·8–62·6°F.]. The pupal stage lasted 40–50 days in the field, but only 34–36 days in the laboratory at a constant temperature of 18°C. [64·4°F.]. The threshold of development for all stages was between 14 and 18°C. [57·2 and 64·4°F.].

Čamprag (D.). **Neka zapažanja o pojavi i štetnosti žutice na šećernoj repi u našoj zemlji.** [Observations on the Appearance and Harmfulness of Sugar-beet Yellows in Yugoslavia.]—*Plant Prot.* no. 35 pp. 23–35, 12 refs. Belgrade, 1956. (With a Summary in English.)

The yellows disease causes considerable losses of sugar-beet throughout Yugoslavia. The principal vector of the virus is *Aphis fabae* Scop., which occurs in the beet fields from May to the end of the season and is most numerous in June–July. It also infests various weeds in or near the fields. Details of the losses in yield in 1955 are given.

Mijin (K.). **Prilog poznavanju biologije** *Dahlbominus fuscipennis* **parazita** *Diprion pini.* [A Contribution to Knowledge of the Bionomics of *Dahlbominus fuscipennis*, a Parasite of *Diprion pini.*]—*Plant Prot.* no. 35 pp. 37–44, 2 figs., 4 refs. Belgrade, 1956. (With a Summary in French.)

*Dahlbominus fuscipennis* (Zett.) is one of the most important parasites of *Diprion pini* (L.) and *Neodiprion* (*D.*) *sertifer* (Geoffr.) on pine in Yugoslavia [*cf. R.A.E.*, A **23** 747]. Investigations on its bionomics, in which the host was *D. pini*, showed that the adults feed on sugary substances throughout their life, and that this feeding controls the number of eggs laid and the survival period. Females survived for 40–50 days with food but only 7–8 days without it and the corresponding periods for males were 8 and 2 days. The females paralyse the sawfly eonymphs before ovipositing in them, and dissection showed that the number of mature eggs contained in the ovaries rose from 16 to 80 per female as the age of the individual increased from 1 to 3–4 days. Fourth- and fifth-instar larvae of *D. fuscipennis* pupated, although prematurely, if removed from their hosts, but younger larvae died.

Tadić (M.). **Da li** *Trichogramma evanescens* **može da se razvija u jajima dudovca.** [Can *T. evanescens* develop in the Eggs of *Hyphantria cunea*?]—*Plant Prot.* no. 35 pp. 83–85, 7 refs. Belgrade, 1956. (With a Summary in French.)

In laboratory experiments in Yugoslavia, fertilised females of *Trichogramma evanescens* Westw. that had developed in the eggs of *Cydia* (*Carpocapsa*) *pomonella* (L.) oviposited in eggs of *Hyphantria cunea* (Dru.) and

normal adults of both sexes were subsequently obtained, though in smaller numbers than from the eggs of *C. pomonella*. Dissection of the parasitised eggs of *H. cunea* showed two pupae of the parasite in each.

Milević (K.). **Suzbijanje gubara u šumama NR Srbije 1955 god. zamagljivanjem iz aviona.** [Control of *Lymantria dispar* in Serbia in 1955 by Means of Aerosols released from Aeroplanes.]—*Plant Prot.* no. 35 pp. 113–130, 2 figs., 9 refs. Belgrade, 1956. (With a Summary in English.)

Some 75,000 acres of forest were treated with DDT aerosols released from aircraft for the control of *Lymantria dispar* (L.) in Serbia in 1955. The results were favourable, especially in heavily infested areas, and showed that treatment is best carried out when half the larvae have hatched. The disadvantages of the method are that beneficial insects are destroyed [*cf. R.A.E.*, A **45** 460] and that the aerosol is carried away by even light breezes.

Weiser (J.) & Veber (J.). **Možnosti biologického boje s přástevníčkem americkým (*Hyphantria cunea* Drury).** [The Possibilities of Biological Control of the Fall Webworm (*H. cunea*).]—*Folia zool. ent.* **3** pt. 1 pp. 55–68, 11 figs., 8 refs. Prague, 1954. (With Summaries in Russian and English.) **II.**—*Čsl. Parasit.* **2** pp. 191–199, 3 graphs, 2 refs. Prague, 1955. (With a Summary in German.) Weiser (J.). **III.**—*Op. cit.* **4** pp. 359–367, 1 pl., 2 graphs, 7 refs. 1957. (With Summaries in Russian and German.)

*Hyphantria cunea* (Dru.) has become established in parts of Slovakia and has proved an important pest of fruit and ornamental trees. Control by means of insecticides is difficult, because of the numerous food-plants of the Arctiid, and some means of biological control was therefore sought. In the investigations described in the first part of this paper, which were made in 1953, the larvae appeared resistant to three strains of *Bacillus thuringiensis* and polyhedral viruses from three species of Lepidoptera, but were susceptible to infection with cocci from *Lymantria dispar* (L.), which, however, soon lost their virulence on culturing, and to microsporidia isolated from the larvae of *H. cunea* by the senior author and described as *Thelohania hyphantriae*, sp. n., in that year.

It is stated in the second part that a suspension of the spores of *T. hyphantriae*, applied to fruit trees, gave 25 per cent. mortality of the larvae in a fortnight and usually complete kill later, but the results were difficult to estimate with accuracy since the dead and dying larvae were destroyed by predators and other organisms. *T. hyphantriae* also infects other pests of fruit trees, including *Malacosoma neustria* (L.), the gold-tail moth (*Euproctis similis* (Fuessly) (*chrysorrhoea*, auct.)), and *Hyponomeuta padellus malinellus* Zell. It causes an acute infection in the first two, which are therefore suitable for use in the laboratory for the production of spores for the preparation of sprays. They can also be used to spread the disease directly in the field. Larvae of *L. dispar* and *Stilpnotia salicis* (L.) were not susceptible to infection.

In the work described in the third part, it was found that good mortality of *H. cunea* could be obtained by spraying only one-third of the larval nests on a tree with the spores of *T. hyphantriae*. First- and second-instar larvae of *E. similis* (*Nygmia phaeorrhoea* (Don.)) that were infected with *T. hyphantriae* through their food before hibernation preserved the microsporidia

through the winter and developed the disease after leaving their winter nests. Since the nests can be kept at low temperatures until September without harming the larvae, viable microsporidia can be preserved in living larvae throughout the year. The spores can be kept in a dry state for a month at room temperature and for 2–3 months at 0°C. [32°F.]. They remain viable on the soil for over a year under favourable conditions, in water suspensions for over 13 months at 0°C., and in dried larvae for over two months at room temperature. Temperatures from −5°C. [23°F.] to 35°C. [95°F.] are not injurious to them, but viability is soon lost at 40°C. [104°F.]. The spores passed unchanged through the gut of various predacious insects, which can thus serve as means of distribution. Microsporidia isolated from the eggs of *H. cunea* in one locality proved infective for the larvae of *H. cunea*, *E. similis* and *L. dispar* and were identified as *Plistophora schubergi* [*cf.* *R.A.E.*, A **15** 385].

Niklas (O. F.). **Untersuchungen über das Auftreten von Krankheiten und Schädigungen, insbesondere über die "Lorscher Seuche"** (*Rickettsia melolonthae* **Krieg**) **in Freiland-Populationen des Maikäfer-Engerlings** (*Melolontha* **spec.**). [Investigations on the Incidence of Diseases and Injuries, with particular Reference to "Lorsch Disease" (*Rickettsiella melolonthae*), in Field Populations of Larvae of *Melolontha* sp.]—*Z. PflKrankh.* **63** pt. 2 pp. 81–95, 5 graphs, 18 refs. Stuttgart, 1956.

In the investigations described, larvae of *Melolontha* were collected from the soil in and near the forest district of Lorsch, to the east of Worms, from the end of July to mid-November 1954 and reared separately in the laboratory in moist sawdust, with pieces of carrot and sprouting wheat as food. They were observed for mortality until 31st March 1955, and the causes of death were ascertained so far as possible. Both *M. melolontha* (L.) and *M. hippocastani* F. occur in the area, but it was not known to which of the species the larvae belonged. Some 8–74 per cent. of the larvae, depending on vicinity, survived throughout the period, and of those that died, 47·3 per cent. were killed by *Rickettsiella* (*Rickettsia*) *melolonthae* (which causes Lorsch disease) [*cf.* *R.A.E.*, A **44** 207], 16·2 per cent. by bacteria, 4 per cent. by fungi (including *Beauveria* sp.), 1·1 per cent. by "dropsy" (Wassersucht) [*cf.* **33** 7], 0·4 per cent. by microsporidia (*Plistophora melolonthae*), 0·2 per cent. by flagellates (*Polymastix melolonthae*), 2·1 per cent. by a combination of two or more of the above, 3 per cent. by nematodes and 0·2 per cent. by Tachinid parasites. In the remaining 25·5 per cent., the cause of death was not known, and these individuals were encountered predominantly in places favourable to the development of Lorsch disease. Of all the larvae taken, 21·9, 9·9 and 66·2 per cent. belonged to the first, second and third instars, respectively, and of these, the percentages that survived to the end of the period were 11·9, 50·8 and 38·9, but half the deaths among the first-instar larvae were apparently due to unsuitable rearing conditions. The highest percentage of deaths from bacterial infection (16·9) occurred in the first instar, and that from *R. melolonthae* (26·6) and the remaining diseases in the third instar. Deaths due to *R. melolonthae* reached a high point in July–August, after which there was a decline, followed by a rise to a further maximum in December–February. A similar periodicity was observed in the occurrence of deaths due to bacteria, fungi and unspecified causes. The occurrence of a peak in winter is thought to have been due to more rapid incubation at laboratory temperatures; under field conditions, it would probably not have occurred until the following summer or autumn.

Diseased larvae were observed on the surface of the soil [*cf.* **44** 207] for

the first time on 8th October, but must have been present before then. Of those reared in the laboratory, 89·6 per cent. were infected with *R. melolonthae*. Numbers tended to decrease as the temperature rose and to increase when it fell, reaching a maximum at the end of October, when ground frost occurred, and diseased larvae continued to be observed until mid-November. The effect of falling temperature was confirmed in an experiment in which healthy larvae and larvae infected with *R. melolonthae* were kept singly in jars filled with sawdust at a temperature of 12–13°C. [53·6–55·4°F.] for five days and were then transferred to 7–8°C. [44·6–46·4°F.]. After a further 24 hours, the diseased larvae had all congregated on or immediately beneath the surface of the sawdust, whereas the healthy ones were all in the lower part of the jars. In a similar test at constant temperatures ranging from 4 to 21°C. [39·2 to 69·8°F.], the effect was much less pronounced.

Krieg (A.) & Langenbuch (R.). **Eine Polyedrose von** *Aporia crataegi* **L. (Lepidoptera). I. Mitteilung.** [A Polyhedrosis of *A. crataegi*. First Communication.]—*Z. PflKrankh.* **63** pt. 2 pp. 95–99, 3 figs., 2 refs. Stuttgart, 1956. (With a Summary in English.)

*Aporia crataegi* (L.) has long been known to be affected by a polyhedral disease [*cf. R.A.E.*, A **12** 573], but the causal virus had not been investigated. Diseased larvae were therefore obtained from the Rhine Palatinate and Heidelberg and studied. The polyhedra and virus rods are described. They were surrounded by a membrane, and multiplication took place in the nuclei of the fat-body, hypodermis and tracheal matrix. The name *Borrelina aporiae* is proposed for the virus.

Sepasgosarian (H.). **Morphologie und Biologie der gelben Apfelspinnmilbe** *Eotetranychus pomi* **n. sp. (Acar., Tetranychidae).** [The Morphology and Bionomics of the yellow Apple Spider-mite, *E. pomi*, sp. n.]—*Z. angew. Zool.* **43** pt. 4 pp. 435–491, 22 figs., 25 refs. Berlin, 1956.

The author reviews the species of *Eotetranychus* that occur in Europe and the United States and describes all stages of *E. pomi*, sp. n., which has been observed on apple near Stuttgart for several years and was found in 1952–54 to be widely distributed in south-western Germany. Examples of it were also received from England. Its bionomics were investigated on apple in the field and laboratory in 1953–54, and the following is based on the author's summary of the results.

*E. pomi* overwinters as the fertilised female, mainly in the axils of the branches. Activity is resumed in late April or the first half of May, and eggs are laid among webbing on the leaves, mainly on the lower surfaces, where the mites chiefly congregate. Six generations developed in the year in the laboratory, but there were four in the field in 1953 and three in 1954. In the field, complete development of the females required an average of 27·4 days in spring, 25·3 in summer and 35·1 in autumn. The corresponding averages in the laboratory were 20·5, 20·5 and 30 days, and the periods for the males were rather less in all cases. The egg stage occupied over 40 per cent. of the total developmental period. Both sexes passed through a larval and two nymphal stages, each followed by a resting period. The optimum temperature for development was 27·5°C. [81·5°F.]. The females laid 25–61 eggs each in the field and 27–98 in the laboratory, the averages being 37 and 48·1. The ratio of females to males was 7:1 in spring, 1·5:1 in summer and 0·7:1 in late autumn, and parthenogenetic reproduction was common when males were scarce; the progeny being male.

Spring temperatures are important for the ultimate size of the population, damp cool weather in May and June hindering reproduction to such an extent that serious damage in August–September is prevented. The injury due to the mite consists in premature leaf-fall and a reduction in fruit size. *E. pomi* is susceptible to acaricides and occurs chiefly in neglected orchards. The usual winter sprays do not reach the females in their sheltered hibernation quarters, but summer sprays were effective, especially when systemic toxicants were used. Systox [diethyl 2-(ethylthio)ethyl phosphorothioate (demeton)] and Metasystox [dimethyl 2-(ethylthio)ethyl phosphorothioate (methyl-demeton)] at 0·08–0·1 per cent. gave 98 per cent. mortality of the mobile stages in a day and complete kill in three days. The mites were destroyed by *Typhlodromus* sp. and *Mediolata mali* (Ewing), of which the former was particularly useful in winter, destroying up to 40 per cent. of the hibernating population. Some control was also afforded by Anthocorids and Coccinellids. Bands of corrugated paper proved useful for trapping the mites migrating to their winter quarters.

Scheiding (U.). **Untersuchungen zur Biologie des Kohlgallenrüsslers *Ceuthorrynchus pleurostigma* Marsham.** [Investigations on the Bionomics of *C. pleurostigma*.]—*Z. angew. Ent.* **39** pt. 2 pp. 186–228, 25 figs., 133 refs. Berlin, 1956.

*Ceutorhynchus pleurostigma* (Marsh.) damages wild and cultivated crucifers, the larvae causing the formation of galls on the root-collar and stem and developing in them and the adults feeding on the stems, leaves and leaf-stalks. The author describes all stages of this weevil, reviews its distribution and food-plants, and gives a detailed account of observations on its bionomics, begun in 1951 and carried out mainly at Aschersleben, in central Germany, and near Berlin. The following is based partly on his summary of the results.

All stages are present throughout the year, but overwintering occurred principally in the larval stage [*cf. R.A.E.*, A **41** 176]. Eggs were observed from March to September–October, and were laid singly, most frequently in the root-collar. The maximum number laid by one female in the laboratory was 143. The egg stage lasted 12–23 days at average soil temperatures of 18–11·6°C. [64·4–52·9°F.]. Among the cultivated crucifers, rape was generally preferred to turnip rape, and maxima of 8, 20 and 29 eggs per plant were laid on rape, white cabbage and red cabbage; on charlock (*Sinapis arvensis*), the figure rose to 32. Infestation of rape and charlock began 8–10 days and that of cabbage and allied plants 3–6 weeks after sowing. There were two main periods of attack on different plants at Aschersleben. On charlock, in 1952–53, mature females were observed from the end of April to mid-May and their offspring left the galls to pupate in the soil from the end of May to mid-June. The larval stage averaged 28 and 32 days, at average temperatures of 15·6 and 15·9°C. [60·1 and 60·6°F.], respectively, and the pupal stage 31 days at an average temperature of 20·6°C. [69·1°F.]. The last adults were observed at the end of July or the beginning of August. On winter rape, in 1951–52, oviposition began at the end of August or the beginning of September and continued for 1–1·5 months, and 50 per cent. of the larvae had left the galls by the middle of the following April. The larval stage lasted 109 and 191 days at average temperatures of 7·3 and 3·1°C. [45·1 and 37·6°F.], and the pupal stage 56 and 58 days at average temperatures of 14·6 and 14·8°C. [58·3 and 58·6°F.]. The adults emerged at the end of May or the beginning of June and were not taken during July–August. At Berlin, in 1952–53, there was only one principal period of infestation, and

observations on cabbage and related plants showed that this corresponded with that on charlock at Aschersleben. The adults lived for up to 7 months in the laboratory and up to 11 months in the field, and males and females were present in equal numbers. The adults evidently enter diapause during the summer [*cf.* **41** 176]. A second generation in the year was reared in the laboratory, and it is considered that one may develop in the field on a different food-plant from eggs laid early in the year, but the existence of two races, each having only one generation a year on different food-plants, seems likely [*cf.* **11** 461].

Parasitism of the larvae in 1951–52 reached 40 per cent. on winter rape and 38 per cent. on cabbage and related plants, the parasites concerned being two Braconids, *Diospilus oleraccus* Hal. [*cf.* **9** 549], which was the more important, and *Triaspis* (*Sigalphus*) *obscurellus* (Nees). It is not certain whether these initially attack the eggs or the larvae, but very young larvae were sometimes found to be parasitised. The parasite usually leaves its host 8–10 days after the latter leaves its gall, and pupates 14 days later. *D. oleraccus* required 3½–4 weeks to complete its development, and the adults emerged 12–15 days before those of the host.

Geier (P.). **Enseignements écologiques du recensement par sondage d'un grand ensemble de pontes de** *Cacoccia rosana* **L. (Lép., Tortricidae), exposées aux attaques d'un parasite** (*Trichogramma cacoeciae* **Marchal, Hym., Chalcididae) et de prédateurs ornithologiques.**—*Mitt. schweiz. ent. Ges.* **29** pt. 1 pp. 19–40, 8 figs., 11 refs. Berne, 1956. (With a Summary in English.)

The finding of abundant egg-masses of *Tortrix* (*Cacoecia*) *rosana* (L.) on trees in a large orchard consisting of apple and pear near Geneva in January 1955, and the observation that the egg parasite, *Trichogramma evanescens cacoeciae* Marchal, was also present, afforded an opportunity to investigate, during an inactive stage of development, methods of sampling applicable to populations of a tree pest, the distribution of a phytophagous insect and a relatively specific parasite, and the possible effect of natural enemies on the distribution and abundance of the host population.

The orchard concerned is described, and the seasonal histories of the two insects are summarised. *Tortrix* has one generation a year, hibernating in the egg stage, and *Trichogramma* has two, ovipositing in summer in the freshly laid *Tortrix* eggs, in which winter is passed, and from early April in the overwintered eggs in the same egg-masses. The orchard was divided into plots, half-plots and tree units, and the sampling unit was a 50-cm. section at the base of a branch selected at random on 1–3 per cent. of the trees, depending on tree density, in every plot. Sampling was done in February, and counts were made of the egg-masses laid in the summer of 1954, fresh egg-masses parasitised by *Trichogramma*, fresh egg-masses attacked by predators, which consisted chiefly of birds, and hatched egg-masses, mostly persisting from 1953. The results are presented in detail and analysed statistically, and the following is based on the author's summary of the results.

Egg-mass and parasite distributions were well fitted by negative binomial series, the implications of which are discussed. At plot level, the density of fresh egg-masses was strongly correlated with the number of egg-masses of the preceding generation. Between sampling units, the number of parasites was mainly determined by the abundance of fresh egg-masses, but the relative frequency of parasites remained fairly constant throughout the orchard, notwithstanding considerable differences in local infestation by the host. Parasite effectiveness (about 8 per cent. parasitism of egg-masses)

appeared to be fairly independent of host density, and too low, in the present instance, to have much effect on it. Attack by birds, which affected about 29 per cent. of the egg-masses, was significantly dependent on host density, and it is thought that it might well result in a host increase, since it was concentrated where egg-masses were densest and would increase the chances of survival of the larvae from the remaining eggs.

Wyniger (R.). **Über die Wirkung von abiotischen Faktoren auf die Entwicklungsvorgänge im Apfelwicklerei.** [On the Effect of abiotic Factors on the Development of the Egg of *Cydia pomonella*.]—*Mitt. schweiz. ent. Ges.* **29** pt. 1 pp. 41–57, 6 figs., 27 refs. Berne, 1956. (With a Summary in French.)

Experiments in Switzerland, in which the threshold of development was taken as 10°C. [50°F.], showed that completion of the egg stage in *Cydia* (*Carpocapsa*) *pomonella* (L.) required an effective total of about 2,000 degree-hours C., whether the eggs were kept at constant temperatures in the laboratory or at varying temperatures in the laboratory or field. The criterion for completion was the hatching of 50 per cent. of the eggs, and the optimum developmental temperature was 32°C. [89·6°F.]. In the laboratory, relative humidities below 50 per cent. had no effect on egg development or hatching at 25°C. [77°F.], but prevented hatching at 32°C. Continuous immersion of young eggs in water at a temperature of 22°C. [71·6°F.] had little effect, 88 per cent. of the eggs completing their development in the normal period and 58 per cent. hatching. Rain is thus unlikely to harm them in the field. The development of the eggs in relation to progressive totals of effective temperature is described, and special observations on the so-called red-ring stage are recorded. This is normally attained when the sum of effective temperatures reaches 400–500 degree-hours C., but its occurrence depended more on exposure to light than on temperature.

Templado (J.). **Datos sobre** *Ooencyrtus kuwanai* **How. (calcídido parásito de** *Lymantria dispar* **L.) en España.** [Data on *O. kuvanae* (a Chalcidoid Parasite of *L. dispar*) in Spain.]—*Publ. Inst. Biol. apl.* **25** pp. 119–129, 2 figs., 17 refs. Barcelona, 1957. (With a Summary in English.)

*Ooencyrtus kuvanae* (How.), which was introduced from the United States and liberated in oak plantations at El Pardo (Madrid) and Villanueva de Cordoba, Spain, against *Lymantria dispar* (L.) [*cf. R.A.E.*, A **33** 310, etc.], had become established by 1929. The adults of this Encyrtid are described, and characters are given differentiating it and *O. masii* (Merc.), an indigenous species that parasitises the eggs of *Malacosoma neustria* (L.) and accidentally those of *L. dispar*.

At El Pardo, *L. dispar* has one generation a year. The larvae hatch mainly in April and pupate in June–July, and the adults emerge soon after, as the pupal stage lasts only 10–15 days. The females oviposit soon after pairing (often laying as many as 600 eggs each), but the eggs do not hatch until the following spring. *O. kuvanae* has 6–7 generations a year. The females deposit their eggs, usually singly, in the eggs of *L. dispar*, and development is completed within the host eggs, the larval stage lasting about three weeks in warm weather and the pupal stage being very short. The ratio of males to females is about 1:4. The adults live for about 5–6 weeks, females longer than males, and the females deposit up to 200 eggs each. Eggs from unfertilised individuals give rise to males only. Winter is passed in the adult stage, and mortality is high if the cold is severe.

Females that survive resume activity as soon as the temperature rises in early spring. In 1956, in spite of the cold winter, females of *O. kuvanae* were observed on the eggs of *L. dispar* on 6th April, and eggs taken to the laboratory gave rise to adult parasites on 15th–20th May. Few eggs of *L. dispar* are left at that time, but sufficient to permit the development of a further generation, the adults of which survive until newly deposited eggs of *L. dispar* are available, after which reproduction continues until winter.

The percentage parasitism by *O. kuvanae* has been reported to be as high as 40 under favourable climatic conditions [*cf.* **13** 434], but is about 20 in Morocco and Portugal [*cf.* **33** 310] and was 20–25 at El Pardo in 1955–56. As it was thought that its low degree of effectiveness might be due to competition by *Anastatus disparis* Ruschka, an indigenous egg-parasite of *L. dispar* in central Spain, the relations of the two were investigated. Like *L. dispar*, *A. disparis* has one generation a year. In 1956, adults emerged at El Pardo from 25th May to 25th June and reached maximum abundance in mid-June. The percentage parasitism by it was about 15. It is concluded from observations in the laboratory that there is little competition between the two, since eggs heavily parasitised by *O. kuvanae* gave rise to a normal percentage of *A. disparis* [*cf.* **21** 222]. It is concluded that *O. kuvanae* should be introduced into all the oak plantations in Spain, though the best control of *L. dispar* is to be expected in regions with a mild winter.

Lespes (L.). **Sur un essai de lutte contre la sésamie du maïs** (*Sesamia nonagrioides* **Lef.**).—*Rev. Zool. agric.* **56** no. 4–6 pp. 46–54. Talence, 1957.

Larvae of *Sesamia nonagrioides* (Lef.) cause serious damage to maize near Port Lyautey, in Morocco, frequently reducing the crop by 95 per cent., and tests on their control were carried out on a hybrid variety in 1956. In the main test, the maize was sown on 31st March, and sprays containing 0·02 per cent. parathion, 0·06 per cent. dieldrin or 0·25 per cent. DDT and a dust containing 0·02 per cent. rotenone were applied to the stems and funnels on 18th–19th and 29th–30th May, 9th–10th and 19th–20th June and 2nd–5th July for control of the newly hatched larvae of the second generation. Sample plants were examined 11 days after each application, and it was found that the percentages of plants infested and (in brackets) of larvae surviving, as compared with no treatment, were 58·3 (35) for parathion, 19·6 (1) for dieldrin, 40·1 (16) for DDT and 51 (19) for rotenone; dead larvae disappeared too rapidly for counts. A relation had previously been found between larval instar, as determined by cephalic measurements, and amount of food consumed, and this was used to estimate the food consumption of the surviving larvae. When the results were corrected according to Abbott's formula [*R.A.E.*, A **13** 331], it was found that the percentage reductions in damage, as compared with no treatment, were 98·5, 80·29, 72·64 and 62·61 for dieldrin, rotenone, DDT and parathion, respectively. At harvest (in August), rotenone and dieldrin gave significant increases of 20 and 10 per cent. in weight of grain, but the differences for parathion and dieldrin were not significant. The percentage reductions in numbers of plants and (in brackets) ears infested, calculated according to Abbott's formula, were 89 (76), 52 (67), 75 (73) and 47 (54) for dieldrin, rotenone, DDT and parathion, respectively. Although dieldrin was thus clearly superior in control of the larvae, it resulted in a lower increase in yield than did rotenone, and this is attributed to phytotoxicity. As many as five applications would not prove economic in practice, but it is considered that the first two or even three could be omitted with no loss of effectiveness and the cost of the dust further reduced by using one with a higher rotenone content.

During a further test, begun in July, in which dieldrin was applied at several different intervals, the percentage reductions in larval damage and (in brackets) in the numbers of plants infested, calculated as before, were 44·68 (46), 32·23 (22), 60·42 (20), and 92·11 (50) for treatment at intervals of 6, 12, 18 and 24 days, respectively. These results confirm the long-lasting effect of dieldrin, but also show its phytotoxic properties, since the fewest applications resulted in the healthiest plants.

Smirnoff (W. A.). **La cochenille du palmier dattier** (*Parlatoria blanchardi* **Targ.) en Afrique du Nord. Comportement, importance économique, prédateurs et lutte biologique.**—*Entomophaga* **2** no. 1 pp. 1–99. 5 pls., 20 figs., 65 refs. Paris, 1957. (With a Summary in English.)

Since about 1940, date palms in Morocco have been severely infested by *Parlatoria blanchardii* (Targ.), which spread rapidly from the Algerian border and has not yet reached its limit. Infestation of the leaves causes the palms to lose their productivity, and the crust of scales on the fruits deprives them of their market and nutritive value. The author briefly reviews the morphology, food-plants and distribution of the Coccid, and describes investigations on its bionomics, ecology and natural enemies begun in 1951, including a method of estimating and forecasting population increases.

The Coccid prefers shaded sites on the palm, preferably with a moist microclimate, and its distribution through an oasis is by no means uniform, trees in the middle being more heavily infested than those at the edges, unless the latter are protected from desert winds or close to water. There are three generations a year, with sometimes a partial fourth, and development is continuous except for a winter diapause of up to two months in January–February and a summer diapause of some of the second- and third-stage nymphs in sites exposed to the sun. Details of the development of the various stages and generations are given.

Natural enemies provide important control in the older centres of infestation in Tunisia and Algeria, but are largely absent from the more recent infestations in Morocco. Investigations on them were carried out in all three countries in 1951–54, and a list is given of the 35 species of predators found, followed by notes on their distribution, morphology and importance. Apart from *Hemisarcoptes malus* (Shimer), which was active in all three countries and destroyed up to 75 per cent. of the Coccids in favourable localities, all were insects, chiefly Coccinellids of the genera *Scymnus* and *Pharoscymnus* [*cf. R.A.E.*, A **43** 124] and Nitidulids of the genus *Cybocephalus* [*cf.* **44** 7]; no parasites of *P. blanchardii* were found. The various predators were unevenly distributed from oasis to oasis, and were usually most numerous where the population of *P. blanchardii* was densest, except when other plants were present and alternative prey available. Details of their abundance and alternative hosts are given. In a newly infested oasis, the first predator to appear was *Chrysopa vulgaris* Schneider [*cf.* **42** 117]. This was followed by *Cybocephalus flaviceps* Rttr. or *C. dactylicus* Peyer., but the Coccinellids did not usually appear for about two years, and invasion was much slower in isolated localities. The main factor limiting the propagation of the predators was climatic, but some were attacked by predators or parasites, notes on which are included [*cf.* **43** 125].

The most promising means of control appeared to be the artificial dissemination of predators, and large numbers of these, chiefly Coccinellids, were collected in Morocco and released in oases to which they had not already spread or in which they were not numerous. Many died, but four species were successfully established at one or more points. Predators were also

introduced in large numbers from Algeria in 1954 and released in selected oases, generally with a reduction in infestation as a result. In addition, *Chilocorus cacti* (L.) was obtained from Texas in December 1954 and released at one point, where it reproduced during the winter, when the other predators are dormant, and spread very slowly. It fed readily on *P. blanchardii* and was not attacked by local parasites.

MARTIN (Henri). **Pests and Diseases of Date Palm in Libya.**—*FAO Plant Prot. Bull.* **6** no. 8 pp. 120–123. Rome, 1958.

The principal pests of date palms in Libya are Coccids. *Parlatoria blanchardii* (Targ.), which is widespread, is of little importance on the coast, though localised outbreaks occur occasionally, but it finds optimum conditions for development in the oases inland, where the fruits are heavily infested in addition to the leaves. It is attacked by predators, including *Cybocephalus palmarum* Peyer. [*cf. R.A.E.*, A **44** 7], but little control is afforded. In a test with insecticides at Hon in April 1957, emulsion sprays were applied to the foliage from near the top of the tree by means of a power-operated sprayer and a long rubber hose provided with a nozzle held by the operator, who climbed the palm. The mortality percentages after a fortnight and (in brackets) a month were 90 (97) for 0·05 per cent. parathion, 97 (96) for 0·05 per cent. diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate] and 60 (59) for 0·05 per cent. malathion. The results were not improved by the addition of 2·5 per cent. white oil, but some evidence was obtained in a further test that a wetting agent was of value with diazinon. White-oil emulsion by itself was not effective. Coccids of less importance are *Phoenicococcus marlatti* Ckll., *Pseudaspidoproctus hyphaeniacus* (Hall), *Icerya purchasi* Mask. and *Aspidiotus hederae* (Vall.).

Other insects infesting the palms comprise *Batrachedra amydraula* Meyr., which has several generations a year and injures the newly set fruits, *Coccotrypes dactyliperda* (F.), the larvae of which develop in the seeds of the fruits, and *Carpophilus hemipterus* (L.), which attacks injured or overripe fruits on the trees as well as on the ground. Mites are of no importance on the coast, though *Eutetranychus banksi* (McG.) was observed on dates at one locality in August 1955, but palms inland are heavily infested by *Oligonychus afrasiaticus* (McG.) [*cf.* **28** 415], which spins fine webs on the dates, in which dust, sand and the nymphal exuviae accumulate. Palms under shelter or poorly tended are the most heavily infested.

The dates are usually stored pressed, but are also stored in bulk inside the house or buried in the sand inland. Those kept in the sand remain sound for a year or more, but the others often become severely infested by insects, those observed comprising *Plodia interpunctella* (Hb.), *Ephestia cautella* (Wlk.), *E. calidella* Gn., *Oryzaephilus surinamensis* (L.), *Tribolium confusum* Duv. and *Carpophilus hemipterus*.

**Outbreaks and new Records.**—*FAO Plant Prot. Bull.* **6** no. 7 pp. 103–106, 1 fig.; no. 8 pp. 123–126, 1 fig. Rome, 1958.

It is reported from India by G. P. Channa Basavanna (pp. 103–104) that the roots of bean plants (*Phaseolus vulgaris*) near Bangalore were found to be infested by *Smynthurodes betae* Westw. (*Trifidaphis phaseoli* (Pass.)), and by M. Puttarudriah & Channa Basavanna (pp. 123–124) that an unidentified Eriophyid was observed on garlic in Mysore. Both these are new records for India, and both pests caused stunting of the infested plants.

Joffe (A.) & Nolte (M. C. A.). **Methyl Bromide Fumigation of horizontally stored Bulk Maize.**—*J. ent. Soc. S. Afr.* **20** no. 1 pp. 144–153, 3 figs., 6 refs. Pretoria, 1957.

A test was carried out in the Transvaal in 1955 on the fumigation of a horizontal mass of 4,000 tons of maize by means of methyl bromide released under a plastic cover, with no forced air circulation. The maize was contained to a height of 15 ft. in a compartment 100 × 107 ft. in area and 16 ft. high, forming part of a larger structure. The surface of the grain was levelled, and covered with plastic sheets, 60 × 60 ft., rolled together or sealed at the edges and supported at a height of about 18 ins. above the maize on a framework of bags of grain and horizontal timbers. The methyl bromide was introduced by means of polythene tubing comprising four main delivery lines, each 80 ft. long, connected in pairs to cylinders of methyl bromide outside the compartment and having eight short arms along each side terminating in coarse nozzles directed downwards at an angle of about 20° from the vertical; the number of nozzles was equivalent to one per 167 sq. ft. of grain surface and 250 cu. ft. of free space. Before fumigation, which was carried out in February at 70–75°F., cages containing 25 adults of *Calandra oryzae* (L.), 40 g. whole maize containing all stages of *C. oryzae*, 20–25 adults of *Tribolium confusum* Duv. with 5 g. coarsely ground maize and, in many, 20–25 adults of *Rhizopertha dominica* (F.) with 5 g. whole wheat, were placed in the free space or just below the surface of the grain or inserted into the grain at depths of 7 and 15 ft. at selected sampling points; cages were also inserted in the grain in a similar but uncovered compartment that served as a control. The methyl bromide was applied at a rate equivalent to 3 lb. per 1,000 cu. ft. free air space, which subsequent small-scale tests established was little more than the optimum dose under the conditions prevailing at the time, and the sheets and the caged insects were removed 24 hours later. The maize was kept under observation for 13 months, during which the surface of the treated grain and the exposed parts of the walls of the compartment were sprayed with insecticides to prevent reinfestation. All the caged insects were killed by the treatment, and the maize remained virtually free from infestation and in good condition throughout the period, whereas the untreated grain became heavily infested and showed considerable heating after six months and had to be fumigated with aluminium-phosphide tablets after a further three to prevent serious loss. In a discussion of the results, the success of the operation is attributed to the sealing of the grain alone, instead of the whole warehouse, which is difficult to achieve; the levelling of the grain, which prevented movement of the methyl bromide down grain slopes; and the large number of jets employed. Temperature gradients in the grain at the time of application showed relatively small differences, which would be expected to favour even distribution.

Büttiker (W. W. G.). *Drosica abjectella* **Wlk.** (**Lepidoptera: Tineidae**) **a Predator on Pineapple Mealybug,** *Dysmicoccus brevipes* **Ckll.** (**Homoptera: Coccidae**).—*J. ent. Soc. S. Afr.* **20** no. 1 pp. 162–163, 4 refs. Pretoria, 1957.

Larvae of *Drosica abjectella* Wlk. were observed preying on *Dysmicoccus brevipes* (Ckll.) on pineapple at Nelspruit (Transvaal) in February 1953. The number of larvae and pupae varied from 1 to 15 per plant. The larvae occurred in the leaf axils and usually pupated at the bases of the leaves. Nymphs and fully fed females of *Dysmicoccus* were preferred, and 14 fourth-instar larvae reared in the laboratory consumed an average of 6·5 females each. In June and July, the fourth instar lasted 15–26 days; the prepupal

stage lasted 1–3 days, and the pupal stage 35–45 days. In July–August, the adults lived for 3–6 days.

Carnegie (A. J. M.). **Observations on the Behaviour of Crawlers of *Lepidosaphes beckii* Newm. (Hom.: Diaspidinae).**—*J. ent. Soc. S. Afr.* **20** no. 1 pp. 164–169, 1 fig., 5 refs. Pretoria, 1957.

The laboratory observations described showed that crawlers of *Lepidosaphes beckii* (Newm.), which is an important pest of *Citrus* in South Africa, do not usually travel far from the parent female before settling and that they are neither positively nor negatively phototropic. They showed a strong tendency to congregate at the points of contact between surfaces.

De Lotto (G.). **Notes on some African Species of *Saissetia* (Homoptera: Coccoidea: Coccidae).**—*J. ent. Soc. S. Afr.* **20** no. 1 pp. 170–182, 6 figs., 12 refs. Pretoria, 1957.

In this paper, which is further to one already noticed [*R.A.E.*, A **44** 293], the author describes five new species of *Saissetia* from Kenya or Tanganyika and states that *S. nigra* var. *nitida* (Newst.) [*cf.* **8** 119] and *S. perseae* Brain [*cf.* **8** 447; **27** 503; **28** 532] are synonyms of *S. nigra* (Nietn.), being identical with two forms of the latter that occur in Africa south of the Sahara. He also redescribes *S. setigera* (Newst.), which is recorded from the leaves of guava in Uganda, and gives a key to the 13 species considered valid in the two papers.

Kriegler (P. J.). **Malathion versus Parathion for the chemical Control of the Mealybug, *Planococcus citri* (Risso) on Vines.**—*J. ent. Soc. S. Afr.* **20** no. 1 pp. 187–188, 4 refs. Pretoria, 1957.

In view of the hazards involved in the application of parathion sprays, the effectiveness of malathion as a substitute for it against *Planococcus citri* (Risso) on vines in western Cape Province was investigated in 1954–55. Both materials were applied as emulsion sprays containing 0·03 per cent. toxicant in schedules comprising a single application on 29th December, or two applications on 29th December and 20th January or 20th January and 8th February. At harvest, the average percentage of bunches infested was reduced from 51·6 to 0·2–0·5 and 11·9 by parathion applied twice and once, respectively. This material was significantly superior to all schedules of malathion, which reduced the percentage infestation best (but only to 24·9) when applied on 29th December and 20th January.

Ossowski (L. L. J.). **The chemical Control of the Wattle Bagworm, *Kotochalia junodi* (Heyl.) by aerial Spraying. II. The Use of Toxaphene and Endrin in the earlier Stages of an Infestation.**—*Bull. ent. Res.* **49** pt. 2 pp. 229–233, 5 refs. London, 1958.

Preliminary work described in a paper [*R.A.E.*, A **44** 453] of which this is a continuation showed that sprays of toxaphene in oil applied from the air against *Kotochalia junodi* (Heyl.) on wattle (*Acacia*) in an area in Natal over which infestation varied in intensity were effective only where populations were light [*cf.* also **44** 177]. Further tests with this material and with endrin, which had shown promise in small-scale tests [**46** 70], were carried out in 1956 in an area in which the population was consistently light, and the following is based on the author's summary of the work.

Replicated sample plots were sprayed from the air with 2 oz. endrin or 1½, 2¼, 3 or 6 lb. toxaphene per acre, each in light diesel oil, and all invertebrates that fell from sample trees were collected on sheets at intervals after spraying. Mortality among larvae of *K. junodi* was assessed after 10–14 days. A very high kill, ranging from 96·6 to 98·5 per cent., was obtained in all plots except those treated with 1½ lb. toxaphene, which was significantly inferior, and even toxaphene at 6 lb. per acre was not sufficient to reduce the population to its endemic level, at which very few larvae occur on occasional trees throughout a plantation. In all cases, the kill was greater in the upper than in the lower parts of the tree crowns [*cf.* **44** 178, 454]. There was no difference in the final percentages of larvae that fell from trees receiving the different treatments, which were all considerably greater than that from the controls, but the initial rate was higher from those sprayed with endrin than from the rest. The other arthropods collected comprised seven insects from the unsprayed sample trees and 301 insects and 33 spiders from the sprayed ones, and the number of individuals of each family, together with the numbers beneficial, harmful or of no importance, are shown in tables. Nearly two-thirds of the total were beneficial, and Hymenopterous parasites comprised about half of these.

Heathcote (G. D.) & Ward (J.). **The Preference shown by *Myzus persicae* (Sulz.) for *Brassica* Plants sprayed with wetting Agents.**—*Bull. ent. Res.* **49** pt. 2 pp. 235–237, 1 ref. London, 1958.

The following is based on the authors' summary. Alates and apterae of *Myzus persicae* (Sulz.), when offered a choice in the laboratory between unsprayed cauliflower seedlings and seedlings sprayed with a 0·1 per cent. aqueous solution of Lissapol N, a non-ionic wetting agent, preferred the sprayed plants, and the difference was statistically significant. Further experiments showed that Aphids similarly preferred treated to untreated turnip seedlings, and the preference for sprayed cauliflower seedlings was also shown when wetting agents of the anionic, cationic and mixed types were used.

Brown (E. S.) & Green (A. H.). **The Control by Insecticides of *Brontispa longissima* (Gestro) (Coleopt., Chrysomelidae–Hispinae) on young Coconut Palms in the British Solomon Islands.**—*Bull. ent. Res.* **49** pt. 2 pp. 239–272, 5 pls. (1 col.), 4 figs., 13 refs. London, 1958.

The following is based almost entirely on the authors' summary of this account of investigations in 1953–56 on the control of *Brontispa longissima* (Gestro) on coconut in the British Solomon Islands, where this Hispid is a serious pest of young palms. The damage caused by the feeding of the adults and larvae on the unopened fronds is described [*cf. R.A.E.*, A **17** 416; **29** 379], and it is stated that attempts to establish *Tetrastichus brontispae* (Ferrière) and *Trichogrammatoidea nana* (Zehnt.) on various islands of the group for control of the Hispid [*cf.* **25** 347; **30** 158] had apparently failed. Damage is most severe on palms up to 4–5 years old, and has interfered seriously with replanting. Fully grown palms are only occasionally damaged severely, probably because of the larger size of the fronds and the shorter intervals at which they are produced. Reports that seedlings of Malayan origin are more readily and severely attacked than those of Samoan or local origin were confirmed, but no variety is resistant enough to be preferable solely for that reason. Treatment with a general fertiliser had no effect on the growth of young palms or the amount of damage by *Brontispa*.

Laboratory tests showed that the deposit from a spray of 0·2 per cent. p,p′DDT was highly effective against the adults and larvae and remained so for 3–4 weeks, that chlordane in a 0·16 per cent. spray became significantly less effective in the third and fourth weeks, and that dusts of DDT, alone or with BHC, showed signs of diminished efficiency in the fourth week, though all these materials were initially as effective as the DDT spray.

In small-plot trials with sprays of DDT or chlordane applied at various concentrations and frequencies, the effects of treatment were assessed by counting living and dead examples of *Brontispa* at suitable intervals, by estimating damage to the youngest open frond, and by measuring the growth of the seedlings. DDT at 0·1, 0·2 and 0·3 per cent. p,p′isomer and chlordane at 0·08, 0·16 and 0·24 per cent. gave very satisfactory control of a heavy attack, and an interval of ten days between applications was better than one of three weeks. Similar trials, with dieldrin at 0·1 per cent. and DDT at 0·3 per cent., were completely effective against a light attack. In further tests, direct comparisons were made between DDT at 0·25 and 0·025 per cent., chlordane at 0·16 per cent. and dieldrin at 0·15 per cent., applied at fortnightly and monthly intervals. The lower concentration of DDT was much less effective than the other treatments. DDT at the higher concentration and dieldrin were equally effective when applied fortnightly, but the latter was superior in the monthly treatments in controlling immigrant beetles, which is attributed to its greater persistence. It is concluded that, in the formulations used, dieldrin is superior to DDT or chlordane. Further trials with dieldrin at 0·15 per cent. showed that palms subjected to only moderate reinfestation were adequately protected by spraying every six weeks; isolated areas of young palms can be left much longer, probably for several months, once the initial population has been controlled. The maximum frequency, under the most adverse conditions, might vary between two and four weeks, initially. Varietal susceptibility in the coconut does not affect the efficiency of control.

Slight phytotoxicity, indicated by retardation of growth and rate of production of new fronds, was caused by frequent applications of high volumes of spray, but the volume necessary to produce such an effect is considerably in excess of that required for satisfactory control. Unnecessarily high volumes and concentrations should, however, be avoided. The spray was applied to each palm, downwards on to the central spike, where the beetle lives. Equipment capable of delivering a fine, low-volume spray controlled by an efficient trigger tap uses only about 16 cc. spray per palm up to three years old. With a low-volume atomiser, this consumption can be reduced to about 6 cc. An imitation aerial spray gave promising but inconclusive results. With the proprietary formulations of insecticides used, the addition of a wetting agent was unnecessary. Field applications were tested in the Russell Islands on extensive areas of young palms that showed heavy beetle attack. Sprays containing dieldrin or DDT, each in two proprietary formulations, gave excellent and satisfactory results, respectively. It is concluded that very satisfactory control can be achieved at low cost, and that a programme of replanting could safely be embarked upon without fear of the severe losses due to *Brontispa* that have occurred in the past.

Scheepers (C. C.) & Gunn (D. L.). **Enumerating Populations of Adults of the Red Locust, *Nomadacris septemfasciata* (Serville), in its Outbreak Areas in East and Central Africa.**—*Bull. ent. Res.* **49** pt. 2 pp. 273–285, 1 graph, 18 refs. London, 1958.

The following is substantially the authors' summary. A method is described for estimating the total numbers and frequency distributions of adults

of *Nomadacris septemfasciata* (Serv.) in outbreak areas of hundreds of square miles, based upon counting the numbers that fly up from a strip two yards wide in front of a moving vehicle. The effect of factors such as temperature, wind and vegetation on the readiness of the locusts to fly is briefly discussed. The method proved valuable for indicating both immediate and future requirements for killing the locusts, but requires refining for some research purposes. By its means, the importance of the congregation of scattered adults throughout the dry season in the formation of emigrant swarms was clearly shown. It has sometimes been thought that the formation of swarms depends on concentrated oviposition by the previous generation, but J. H. Lloyd and W. N. Yule, using the assessment method here described, showed that in 1956 there was a dispersal just before eggs were laid. The total population in a part (189 sq. miles) of the North Rukwa outbreak area (a self-contained area of 253 sq. miles) in Tanganyika was studied over a period of four years. Indications were obtained that a small migrant swarm contains 5–10 million locusts and that a total population of 20 million locusts in the whole of the outbreak area is unlikely to yield a migrant swarm, though one of 50 million could readily do so. In 1953, after poor rains, no natural mortality was detected between July and October from population assessments made from a Land Rover, but in 1957, after good rains, a natural mortality of 70–90 per cent. was shown by assessments made by means of a Land Rover, an amphibious vehicle and scouting on foot [*cf. R.A.E.*, A **43** 293–294], although the dry season was not fully covered.

Benson (R. B.). **A new European Species of** *Pachynematus* **Konow (Hymenoptera, Tenthredinidae) feeding on Spruce** (*Picea*).—*Bull. ent. Res.* **49** pt. 2 pp. 301–303, 9 figs., 4 refs. London, 1958.

*Pachynematus styx*, sp. n., is described from adults of both sexes reared from larvae collected on spruce (*Picea abies*) in central Germany in 1951 and 1954, and characters are given distinguishing it from two closely related species. *Pikonema* [*R.A.E.*, A **26** 293] is considered congeneric with *Pachynematus*.

Long (D. B.). **Observations on Oviposition in the Wheat Bulb Fly,** *Leptohylemyia coarctata* **(Fall.).**—*Bull. ent. Res.* **49** pt. 2 pp. 355–366, 10 figs., 9 refs. London, 1958.

In the observations described, which were carried out at Rothamsted, field-collected females of *Hylemyia* (*Leptohylemyia*) *coarctata* (Fall.) were kept in lamp-glass cages, each with a floor of black nylon mesh screen and a muslin top from which three tubes containing diluted sweetened condensed milk, Bovril solution, or honey solution were suspended. The cages stood on glass blocks on damp, black filter papers in petri dishes, and were transferred every hour to fresh ones, so that the eggs laid on the filter papers during the previous hour could be counted. The following is based on the author's summary of the results.

A daily oviposition rhythm was observed, in which egg-laying was virtually restricted to the afternoon and evening, with a maximum in the two hours before nightfall. The time of oviposition coincided with that period in the diurnal flight rhythm in which the flies actively congregate on wheat [*cf. R.A.E.*, A **46** 168], and it is suggested that this might account for the finding that oviposition occurs mostly on sites close to an infested crop [*cf.* **46** 170]. The oviposition rhythm was maintained for 24 hours in the absence of light and therefore appeared to be partly inherent. However, it was influenced by the times of exposure to light and disappeared in constant light. Darkness did not appear to affect the egg-laying rate, but a temporary increase

followed exposure to continuous light. Within the experiments, the rate was not affected by small changes in temperature.

The individual fly laid up to 180 eggs in periodic batches of up to 42 eggs, each batch being laid over a period of 1–6 days. This periodicity was obscured in cages containing a number of flies, and disproportionately small decreases in the mean daily laying rate occurred with increases in this laying period. Within the laying period, the rate progressively increased with each successive day. The total number of eggs laid was not related to the number of ovarioles. The rate of laying increased with age, and most of the eggs were laid by relatively few flies. The rate of egg-laying and survival at different stages in the field is discussed, and it is suggested that about 2 per cent. of the eggs successfully develop as matured females, and that these lay an average of about 50 eggs each.

Ingram (W. R.). **The Lepidopterous Stalk Borers associated with Gramineae in Uganda.**—*Bull. ent. Res.* **49** pt. 2 pp. 367–383, 3 maps, 9 refs. London, 1958.

The following is substantially the author's summary. The Lepidopterous stalk borers that occur in Uganda in association with graminaceous plants were studied during 1954–56 by collecting on all likely food-plants at two centres and by a country-wide survey in which stalk-borer damage in cereal crops was qualitatively assessed at five-mile intervals along the routes followed and the species present in such crops and, where possible, in neighbouring wild food-plants were determined. The commonest Noctuids were *Busseola fusca* (Fuller), *B. segeta* Bowden, *Sesamia calamistis* Hmps. and *S. poephaga* Tams & Bowden. All these attacked sorghum (*Sorghum vulgare*), maize, sugar-cane and (except the last) finger millet (*Eleusine coracana*); so also did *Sesamia botanephaga* Tams & Bowden, but only near swamps, in which it infested sedges (*Cyperus* spp.) and reeds (*Typha australis*), from which the other species were virtually absent. Only *S. calamistis* and *S. botanephaga* attacked rice. All attacked *Pennisetum purpureum*, *Sorghum verticilliflorum*, *Vossia cuspidata* and (except *Sesamia botanephaga*) *Panicum maximum*, and also other wild grasses.

*B. fusca* was widely distributed, but most abundant in areas of intensive cultivation, with abundant crop residues in which the resting larvae survive the dry season. *B. segeta* was the most frequent species in *Pennisetum purpureum* and *Panicum maximum*, which are extremely common over most of the country, but was rare in cereal crops. *S. calamistis* [*cf. R.A.E.*, A **41** 68] was not numerous but occurred in every district except Karamoja, where it cannot survive the dry season; and *S. poephaga* is known only from northern and eastern districts and is unimportant.

*Chilo zonellus* (Swinh.), which may be a recent introduction, occurred in all the cultivated food-plants and most of the wild ones except *Cyperus* and *Typha*; it was not found at altitudes above 4,000 ft. in the west or 5,000 ft. in the north and east, but elsewhere it was the prevalent borer and can cause severe damage in dry years and on out-of-season crops. It was the only species besides *B. fusca* found on bulrush millet (*Pennisetum typhoides*), the tough stem of which resists attack. On the western border, *Eldana saccharina* Wlk. attacked sorghum, maize and sugar-cane at high altitudes, and *Maliarpha separatella* Rag. attacked rice. A fourth Pyralid, *Pectinigeria* sp., occurred on maize.

When small plots of food-plants were grown within a large area under sorghum, and also in a swamp, and the whole sampled at harvest for borer infestation, all the cultivated food-plants and many of the wild ones suffered some attack, the percentage of stems bored varying from 10 (in finger

millet) to 89 (in sorghum) amongst the former, and reaching 34 (in *Panicum maximum*), 40 (in *Sorghum verticilliflorum*) and 50 (in *Pennisetum purpureum*) amongst the latter. Immature stages of *C. zonellus* and *B. fusca* greatly outnumbered those of *Sesamia*, especially in the more heavily infested food-plants.

Notes are given on the life-histories of the commoner species and on their habits in the field. In the laboratory, the lengths of the life-cycles, in days, were 68–75 for *B. fusca*, 65–78 for *B. segeta*, 46–58 for *S. calamistis* and 46–53 for *C. zonellus*. In the dry season, the larvae of *B. fusca* entered a resting stage, which prolonged the life-cycle to 200 days; such larvae were found only in living or dry stems of crop plants. *C. zonellus* and *Sesamia* spp. bred continuously, in the dry season the former being found chiefly in trash, stubble and volunteer tillers of sorghum and the latter in these and living stems of grasses.

Of the principal cereal crops in Uganda, sorghum is the most widespread. The main crop, which is sown after the longer of the two dry seasons, suffers little borer attack; second crops are more severely affected, but plants with thick stems or numerous tillers nevertheless yield heavily. Finger millet is the staple food crop in the north and west; borer damage is negligible and restricted to small patches of dead-hearts caused by larvae from single egg-masses of *S. calamistis*. Maize is grown on a large scale in the districts bordering Lake Victoria and in the highlands; borer attack is usually very late and, where rainfall is adequate, appears not to affect yields.

*Apanteles sesamiae* Cam. and another Braconid, as yet unidentified, probably control *S. calamistis*, but the incidence of parasites, which are listed, on the other stalk borers is low. Destruction of all crop residues and wild species of *Sorghum* round cultivated areas would considerably reduce borer attack at the beginning of the growing season, but chemical control was only partly effective and did not increase the yield [*cf.* **44** 447].

DAVEY (P. M.). **The Groundnut Bruchid,** *Caryedon gonagra* **(F.).**—*Bull. ent. Res.* **49** pt. 2 pp. 385–404, 3 figs., 58 refs. London, 1958.

The following is substantially the author's summary. Information on the world distribution and food-plants of the groundnut Bruchid, *Caryedon gonagra* (F.), is summarised from the literature. The beetle has been frequently misidentified [*cf. R.A.E.*, A **46** 114], but the records here included are all believed to refer to *C. gonagra* and some have been confirmed by B. J. Southgate. *C. gonagra* is widely distributed in the Old World tropics and sub-tropics, but it is absent from Australasia and has only a restricted distribution in the New World tropics. Almost all its food-plants are leguminous, and the principal one is tamarind, *Tamarindus indica*, in the pods of which the beetle has been found to develop more quickly than in groundnuts. Data on its bionomics are summarised from the literature, and an account is given of laboratory experiments to determine the optimum conditions for multiplication, in which groundnuts were provided as food. When females were allowed to lay large numbers of eggs on shelled and unshelled groundnuts, only a small proportion of the resulting larvae completed their development, the numbers of adults that emerged averaging about 2·4 per kernel in shelled and 3·2 in unshelled groundnuts. The development period at 70 per cent. relative humidity was 42 days at 30°C. [86°F.] and 91–98 at 25°C. [77°F.]; the former figure is lower than any recorded in the literature at higher or lower temperatures, and all subsequent experiments were therefore made at 30°C. and 70 per cent. relative humidity. Adults confined for three weeks, beginning when they were four days old, on a mixture of broken and intact kernels at a rate of 25 pairs per 160 g.

gave rise to some 314 $F_1$ adults; this total was virtually unchanged when 50 pairs were used, but lower densities, though giving rise to greater yields per parent adult, gave much lower yields per weight of food. Emergence of adults began six weeks after the beginning of oviposition and reached its peak 1–3 weeks later. The yield from ten females on intact kernels was greater than that from the same number on the mixture, but differed little whether the parent adults were left for one week or three weeks, indicating that most of the eggs are laid in the first 11 days of adult life. The yield from unshelled groundnuts was nearly twice as great as that from shelled ones, and also significantly larger than that from shelled groundnuts with ground shell added, possibly because the unshelled nuts provide better protection and a more favourable microclimate for the developing larvae and also permit greater freedom of movement to the ovipositing females. Characters of the terminal abdominal segments enabling the sexes to be distinguished in the adult stage by the naked eye are described in an appendix.

Miles (M.). **Studies of British Anthomyiid Flies. IX. Biology of the Onion Fly,** *Delia antiqua* **(Mg.).**—*Bull. ent. Res.* **49** pt. 2 pp. 405–414, 12 refs. London, 1958.

The following is almost entirely the author's summary of this account of laboratory investigations carried out in south-eastern England in 1953–56 to obtain further information on the bionomics and reaction to temperature of the onion fly, *Hylemyia* (*Delia*) *antiqua* (Mg.) [*cf. R.A.E.*, A **43** 165], which forms part of a series [*cf.* **45** 222, etc.]. A comparison of the dates of emergence of overwintering generations of *H. antiqua* and *H.* (*Erioischia*) *brassicae* (Bch.) in an insectary showed that the former emerged consistently about a month later than the latter. This supported the observations of previous workers that *H. antiqua* was not active in the field until late May [*cf.* **26** 298]. A diet containing protein was necessary for oviposition by *H. antiqua*. The duration of the preoviposition period was affected by temperature. Flies maintained at 25°C. [77°F.] laid eggs in 10–24 days, with an average of 15 days. At spring and summer laboratory temperatures (12–29°C. [53·6–84·2°F.]), the preoviposition period lasted 10–25 days, with an average of 15, and in autumn and winter (11–20°C. [51·8–68°F.]), it lasted 11–46 days, with an average of 21. Flies maintained at 6–8°C. [42·8–46·4°F.] did not lay eggs. Flies in captivity laid up to 123 eggs each, at the rate of 1–45 per day. Intervals between batches of eggs varied from 1 to 9 days, and the oviposition period occupied 7–25 days. Flies lived for up to six days after oviposition.

The incubation period depended on temperature. Eggs hatched in two days at 25°C., in 3–4 days at 20°C., in 4–6 days at 15°C. [59°F.] and in 9–14 days at 7–10°C. [44·6–50°F.]. The temperature also affected the duration of the larval and pupal stages. At 25°C., the three larval instars required 2, 2 and 5–9 days, respectively. Lowering the temperature increased the time for development until the three instars required 8–12, 8–18 and 24–37 days, respectively, at 9–11°C. [48·2–51·8°F.]. The pupal stage lasted 12–17 days at 25°C., 16–25 days at 20°C. and from 35 days to over a year at 15°C. Development from egg to adult was completed in 25 days at 25–30°C. [77–86°F.], 28 days at 25°C., 30 days at 22–27°C. [71·6–80·6°F.], and 33 days at 19–24°C. [66·2–75·2°F.].

At 25°C., *H. antiqua* developed continuously without diapause. When larvae were reared at temperatures below about 18°C. [64·4°F.], pupal development was often retarded. Pupae formed from larvae reared at 12–18°C. and maintained at approximately that temperature required 94–442

days to complete their development. By raising the temperature of pupae formed from larvae reared below 18°C., it was demonstrated that a true diapause had been induced. Of 54 pupae raised to 25°C., 8 (15 per cent.) completed their development in the expected time (13–16 days) and 46 (85 per cent.) required 94–208 days. Of 322 pupae formed from larvae reared in an insectary in May and June at 10–18°C. and exposed to July temperatures of 13–20°C. [55·4–68°F.], 37 (11 per cent.) emerged in 25–35 days, 33 (11 per cent.) in 66–212 days and 252 (78 per cent.) in 234–294 days. Similarly, of 283 pupae formed from larvae reared at 12–21°C. [53·6–69·8°F.] and exposed to a temperature of 15–23°C. [59–73·4°F.], 30 (11 per cent.) completed their development in 21–31 days, while 253 (89 per cent.) required 118–341 days. Exposure to low temperatures was not necessary to terminate the diapause.

Banks (C. J.). **Observations on the Behaviour and Mortality in Coccinellidae before Dispersal from the Egg Shells.**—*Proc. R. ent. Soc. Lond.* (A) **31** pt. 4–6 pp. 56–60, 1 pl., 2 figs., 7 refs. London, 1956.

The following is based on the author's summary. Observations at Rothamsted on *Coccinella septempunctata* L., *Adalia bipunctata* (L.) and *Propylea quatuordecimpunctata* (L.), which are the three common Coccinellid predators of Aphids on beans [*Vicia faba*] in southern England, showed that important causes of mortality in the egg stage were infertility and destruction of the eggs by newly hatched larvae of the same batch [*cf. R.A.E.*, A **44** 2]. The extent of this predatory activity appeared to be associated with the size of the egg batch; in *C. septempunctata* and *A. bipunctata*, which have large or medium-sized egg batches, 10–12 per cent. of the fertile eggs were destroyed by newly hatched larvae, and in *P. quatuordecimpunctata*, of which the egg batches are small and the larvae usually hatch together, about 6 per cent. were destroyed in this way. Infertile eggs were not common in *A. bipunctata* and *P. quatuordecimpunctata*, but they occurred regularly in *C. septempunctata* and were always eaten by the larvae. An experiment in which the provision of one egg of its own species to a newly hatched larva of *A. bipunctata* almost doubled its life showed the advantage of such food in prolonging the time it could search for Aphids. Larvae that fed on two and three eggs lived even longer and were able to develop to the second instar without feeding on Aphids.

El-Ziady (S.) & Kennedy (J. S.). **Beneficial Effects of the Common Garden Ant, *Lasius niger* L., on the Black Bean Aphid, *Aphis fabae* Scopoli.**—*Proc. R. ent. Soc. Lond.* (A) **31** pt. 4–6 pp. 61–65, 3 refs. London, 1956.

Investigations on the effect exerted by ants on the development of *Aphis fabae* Scop. were carried out at Cambridge in 1954 and 1956 with Aphid colonies consisting of equal numbers of adult apterous virginoparae on plants of broad bean (*Vicia faba*) in pots and natural ant populations. In field tests, colonies from which *Lasius niger* (L.) was excluded were found after three weeks to be still small, composed largely of alates, and heavily attacked by natural enemies, and the plants were much contaminated with exuviae, honeydew and moulds, whereas colonies tended by ants contained few alates, were large, densely aggregated and only lightly attacked, and the plants were clean. The ants removed or drove away larvae and adults of *Adalia bipunctata* (L.), adults of *Coccinella septempunctata* L., *Propylea quatuordecimpunctata* (L.) and *Aphidius* sp. and Syrphid larvae that were placed on the infested plants in their absence; they ignored adult Coccinellids on the pots and Syrphid and Coccinellid eggs on the plants, but the larvae that

hatched from these quickly disappeared. Colonies from which both natural enemies and ants were excluded contained after 12 days 277 Aphids, of which 50·2 per cent. were alates; the corresponding figures for colonies to which only natural enemies had access were 209 and 65·6, whereas those for colonies to which only ants had access were 384 and 8·9. The direct beneficial effect exerted by the ants was confirmed in a glasshouse experiment in which, in the absence of natural enemies, the numbers of Aphids and the percentages of alates were 220 and 1 after 14 days in colonies that were attended by *L. niger* and 133 and 46 in those that were not.

Taylor (C. E.). **Aphid Infestations and the Growth of the Potato Plant.** —*Yearb. nat. Ass. Seed Pot. Merch. 1956* pp. 18–27, 2 graphs, 11 refs. London, 1957.

Although the 100-leaf sample is probably reliable for the assessment of Aphid numbers in a potato crop when general surveys are made [*cf. R.A.E.*, A **22** 386], it gives little indication of the distribution and development of the colonies on the plants or of the influence of plant growth on colonisation. In investigations in central England, three stages of growth of potato plants were distinguished, and a sampling method was adopted whereby counts were made on leaves selected from five specified leaf-zones on the main stem and three on the axillary shoots, so that plant growth was allowed for. Observations showed that *Myzus persicae* (Sulz.) colonised the lower leaves first, spreading upwards as the leaves entered the senescent stage [*cf.* **43** 281], whereas *Macrosiphum solanifolii* (Ashm.) preferred the young, growing leaves at the tips of the shoots and *Aphis nasturtii* Kalt. was more generally distributed. The effect of these differences on the infestation of varieties of potato differing in growth habit and leaf type are illustrated from plot tests.

Shaw (M. W.). **Aphids and Seed-potato Growing in Scotland.**—*Agric. Rev.* **3** no. 1 pp. 28–36, 5 figs., 16 refs. London, 1957.

Notes are given on the appearance, bionomics and local occurrence of *Myzus persicae* (Sulz.), *Macrosiphum solanifolii* (Ashm.) (*euphorbiae*, auct.), *M.* (*Aulacorthum*) *solani* (Kalt.) and *Aphis nasturtii* Kalt., the four Aphids commonly found on potato in Scotland [*cf. R.A.E.*, A **27** 563; **43** 279]. The most important is *Myzus persicae*, which transmits the leaf-roll and severe-mosaic viruses of potato, and the successful production of virus-free seed potatoes in Scotland depends on its scarcity before July, when the plants are young and most susceptible to infection. Potato haulms should be destroyed in autumn, and cruciferous crops, on which the Aphid overwinters, removed in spring, before alates are produced.

Tambs-Lyche (H.). **Aphids on Potato Foliage in Norway. II. Investigations of Potato Fields in North Norway.**—*Norsk ent. Tidsskr.* **10** pt. 2–3 pp. 73–90, 3 figs., 15 refs. Oslo, 1957.

In the first part of this paper [*R.A.E.*, A **41** 96], the author reported the results of a survey of Aphids on potato in Norway mainly south of Trondheim Fjord. In this second part, she describes a similar survey carried out in 1950 from Trondheim as far north as Tromsø. Records of the Aphids found are shown in a list, which is followed by notes on the individual species and a brief discussion. Some changes adopted in the names used for the more important Aphids are noted. Of the five main ones found in southern Norway [*cf. loc. cit.*], all but *Aphis nasturtii* Kalt. (*rhamni*, auct.) also

occurred on potato in the north. *Macrosiphum* (*Aulacorthum*) *solani* (Kalt.) was the commonest, its frequency decreasing from south to north. Both it and *M. solanifolii* (Ashm.), which was more scattered in distribution, occurred up to the northern limit of the survey, and their distributions in the whole of Norway are shown on maps. It was not known how they overwintered, but it may have been indoors. *Myzus* (*Myzodes*) *persicae* (Sulz.) was recorded at only one locality, Skogn, and is probably dependent on indoor hibernation throughout the country. *Aphis gossypii* Glov. (*frangulae*, auct.) was likewise found at only one place, Leinstrand. Of the other Aphids found, *Capitophorus* (*Cryptomyzus*) *galeopsidis* (Kalt.) occurred on potato in association with *Galeopsis* spp., to which it migrates in summer, and *Myzus padellus* H.R.L. & Rogerson, which had not been found by its authors since its original description from *Prunus padus* in Britain in 1946, was also found on potato in association with *Galeopsis*, to which it migrates from *P. padus*, its winter food-plant. *M. padellus* was found only north of Trondheim; its distribution there is illustrated on a map. Briefer notes are given on the other 13 species observed, most of which were chance-comers.

The summer of 1950 was unusually dry, but infestation of potato was only light, though Aphids were common on other plants. Of the species commonly regarded as vectors of potato viruses, only *Macrosiphum solani* and *M. solanifolii* seemed likely to be of any potential importance, but nothing is known in this respect of *Myzus padellus* or *C. galeopsidis*, though these were numerous enough to serve as vectors of non-persistent viruses, should they prove able to transmit.

Parker (J. R.) & Wakeland (C.). **Grasshopper Egg Pods destroyed by Larvae of Bee Flies, Blister Beetles, and Ground Beetles.**—*Tech. Bull. U.S. Dep. Agric.* no. 1165, ii + 29 pp., 3 maps, 7 refs. Washington, D.C., 1957.

The data on which this paper is based were obtained in the course of grasshopper egg surveys carried out in the western and midwestern parts of the United States between 1936 and 1950, and the grasshoppers concerned were mostly *Melanoplus* spp. and *Camnula pellucida* (Scudd.). The average annual percentages of egg pods destroyed by Bombyliids, Meloids and Carabids in 16 study areas in seven States in 1938–40 were 6·18, 8·8 and 2·89, respectively, with a maximum total destruction of 77·52 per cent. in one county in North Dakota in 1939, and the average annual percentage destroyed in six counties in California was 27·6, with a maximum of 59·9 per cent. in one county in 1937. Destruction of egg pods was much less in grassland than in crop soils. There was a tendency for destruction to be greatest in years of heavy oviposition, but this did not invariably occur. The commonest predators were the Meloids, *Epicauta maculata* (Say), *E. puncticollis* Mannh. and *E. fabricii* (Lec.), the Bombyliids, *Systoechus vulgaris* Lw. and *Aphoebantus hirsutus* Coq., and the Carabids, *Amara obesa* (Say) and *A. hesperia* Csy.

Wakeland (C.). **The High Plains Grasshopper. A Compilation of Facts about its Occurrence and Control.**—*Tech. Bull. U.S. Dep. Agric.* no. 1167, iv + 168 pp., 27 figs., 2 fldg. maps, 12 pp. refs. Washington, D.C., 1958.

*Dissosteira longipennis* (Thos.) is confined to the High Plains of the United States and was of only minor importance until 1933, when a widespread outbreak began that lasted until 1940. During this period, the grasshopper became migratory, swarms of adults flew for hundreds of miles and

hopper bands covered considerable distances. The States affected were Colorado, Kansas, New Mexico, Oklahoma and Texas, and extensive and costly control operations were required to prevent the destruction of large areas of range forage. The distribution and history of the grasshopper up to 1940 is recorded, its bionomics are described and details are given of the control measures applied, which consisted chiefly in the distribution of poison baits. *D. longipennis* has been of no importance since 1940, but the need for regular surveys to detect incipient outbreaks is emphasised.

Gibson (K. E.), Lane (M. C.), Cook (W. C.) & Jones (E. W.). **Effect of some Crop Rotations on Wireworm Populations in irrigated Lands.**—*Tech. Bull. U.S. Dep. Agric.* no. 1172, [1+] 19 pp., 4 figs., 4 refs. Washington, D.C., 1958.

A study of the effects of crop rotation on wireworm populations [*cf. R.A.E.*, A **30** 520] was carried out at Prosser, Washington, from 1936 to 1946, and the following is based on the authors' summary of the results. Wireworm populations were estimated in March by sifting the soil from samples 1 sq. ft. (1936–38) or 0·25 sq. ft. (1939–46) in area and 2 ft. deep taken in the various plots. The wireworms present consisted almost entirely of *Limonius canus* Lec. and *L. californicus* (Mannh.). Six 7-year, two 5-year, four 4-year and five 2-year rotations were studied, as well as five crops grown continuously. The rotations consisted of four years of lucerne followed by row crops of maize, sugar-beet and potato, three years of lucerne followed by maize and potato or potato and maize, two years of sweet clover [*Melilotus*] followed by two years of row crops, and 2-year rotations of wheat, maize, sugar-beet or potato, and the continuous crops were lucerne, wheat, maize, sugar-beet and potato.

Wireworm numbers were greatest in the continuous plots of wheat and potato and low or moderate in the plots of maize, lucerne and suger-beet. In the 2-year rotations, populations were greatest in the wheat-potato plots, lowest in the beet-maize plots, and intermediate in the others. In the 4-year rotations including two years of sweet clover and two of row crops, fairly high populations were maintained. The lowest numbers were in the 7-year rotations including four years of lucerne.

Potato apparently favoured the reproduction and survival of *L. canus*, but had the opposite effect on *L. californicus*. Lucerne tended to reduce the numbers of both species, particularly *L. canus*, to levels below those generally found in row crops. Thus, the combination of four years of lucerne and three years of row crops resulted in the smallest total population.

Rotations including lucerne for four years proved desirable, and potato was best planted immediately after it, wireworm injury to the tubers being greater when potato was grown after other row crops, although populations were about the same. Short rotations and continuous crops were undesirable, since large populations usually developed in them and damage to susceptible crops was heavy.

The number of adult beetles produced was larger under potato, particularly for *L. canus*, but was apparently decreased by sweet clover and lucerne. Production and survival of larvae seemed greatest in plots of wheat and potato, and large populations were generally found in these crops.

Mulla (M. S.). **The Biology of** *Typhlocyba prunicola* **Edwards and** *T. quercus* **(Fabricius) (Cicadellidae-Homoptera).**—*Ann. ent. Soc. Amer.* **50** no. 1 pp. 76–87, 9 figs., 27 refs. Washington, D.C., 1957.

In the course of investigations on *Typhlocyba prunicola* Edw. on prune in California, *T. quercus* (F.) was found infesting both prune and cherry in

the Santa Clara Valley [*cf. R.A.E.*, A **44** 242]. The author reviews the synonymy and distribution of these Cicadellids, describes all stages of both of them, including characters differentiating the nymphs in all stages, and gives an account of investigations on their bionomics, carried out in Santa Clara County in 1953–54. The following is based on his summary of the results.

*T. prunicola* has two generations a year. Eggs deposited in early autumn under the bark, mainly on wood 2–4 years of age, overwinter and hatch mostly in March or early April. The nymphs feed on the leaves, and sometimes on the shoots, causing stippling, and give rise to adults in late April. The preoviposition period lasts 2–3 weeks, and the first-generation eggs are laid in the midribs of the leaves. They hatch in about a month, the nymphs appearing in early July, and the adults emerge at the end of the month. The overwintering eggs are laid mainly in September and October. *T. quercus* has only one generation a year [*cf. loc. cit.*], the eggs hatching 2–4 weeks later than those of *T. prunicola*. The adults appear in mid-May, and oviposition begins in early June. The two species cause similar damage.

Ross (H. H.) & Moore (T. E.). **New Species in the** *Empoasca fabae* **Complex (Hemiptera, Cicadellidae).**—*Ann. ent. Soc. Amer.* **50** no. 2 pp. 118–122, 17 figs., 3 refs. Washington, D.C., 1957.

It has been considered that the large spring populations of *Empoasca fabae* (Harris) that occur in the eastern and midwestern United States might arise as a result of migration from territories to the south. Since comparison of material from such territories would possibly throw light on the origin of these supposed migrants, specimens that on existing criteria would have been identified as *E. fabae* were examined from Central and South America and the West Indies, in addition to some from the United States. They were found to comprise eight species distinguishable by characters of the male abdomen. *E. fabae* is restricted arbitrarily to the form defined as that species by DeLong [*R.A.E.*, A **19** 310] and Medler [**32** 144], which was found only in the material from the United States, and seven new species are described. These are *E. hastosa*, which is recorded from Cuba, Honduras, Mexico, the Panama Canal Zone and Florida and is stated to be a common species on beans in the Central American and Caribbean regions, *E. kraemeri*, which is recorded on beans in Colombia, Cuba, Mexico and Nicaragua and on squash in Nicaragua, and also from Honduras, the Panama Canal Zone, Porto Rico and Florida, *E. panisca*, from Cuba and Honduras, *E. eccla*, from Honduras and the Canal Zone, *E. canda*, on beans in Colombia and Cuba and also from Haiti, Honduras, the Canal Zone and Porto Rico, *E. mexara*, on lucerne in Mexico and Arizona, and *E. verdia*, from Honduras and Mexico. A key to the males of the eight species is included.

Dean (H. A.). **Predators of** *Oligonychus pratensis* **(Banks), Tetranychidae.**—*Ann. ent. Soc. Amer.* **50** no. 2 pp. 164–165, 7 refs. Washington, D.C., 1957.

In view of the increasing numbers of *Oligonychus pratensis* (Banks) found in the Lower Rio Grande Valley of Texas, a survey of the natural enemies of this mite on maize, sorghum and Rhodes grass [*Chloris gayana*] was carried out in 1955. Those found comprised *Stethorus punctum* (Lec.),

*Scolothrips sexmaculatus* (Perg.), *Orius insidiosus* (Say), *Hippodamia convergens* (Guér.), *Chrysopa rufilabris* Burm., *Olla abdominalis* (Say), *Pronematus ubiquitus* (McG.), *Typhlodromus fallacis* (Garman) and *T. mesembrinus*, sp.n., which is described from females found feeding on *Oligonychus pratensis* on the lower surfaces of sorghum and maize leaves. The most important of all these predators was *Stethorus punctum*.

Beck (S. D.) & Stauffer (J. F.). **The European Corn Borer, *Pyrausta nubilalis* (Hubn.), and its principal Host Plant. III. Toxic Factors influencing larval Establishment.**—*Ann. ent. Soc. Amer.* **50** no. 2 pp. 166–170, 3 graphs, 14 refs. Washington, D.C., 1957.

The following is virtually the authors' summary of this part of a series [*cf. R.A.E.*, A **46** 262]. In a laboratory study of the factors influencing the establishment and survival of larvae of *Pyrausta nubilalis* (Hb.) on maize plants in Wisconsin, it was found that two or more toxic substances occur in the plant tissues. These toxicants have a deleterious effect on the growth and survival of borer larvae, and also have an inhibitory effect on the growth of a number of other organisms. One of the toxic substances has been isolated in pure form and is called Resistance Factor A. The Resistance Factor A content of two dent maize inbreds was found to differ in agreement with their relative resistance to infestation by the borer under field conditions. Resistance Factor A content of whorls and whole plants was found to decline with increasing plant height, as does resistance to borer establishment.

Huffaker (C. B.) & Kennett (C. E.). **Experimental Studies on Predation: Predation and Cyclamen-mite Populations on Strawberries in California.**—*Hilgardia* **26** no. 4 pp. 191–222, 5 graphs, 57 refs. Berkeley, Cal., 1956.

In California, *Typhlodromus cucumeris* Oudm., *T. reticulatus* Oudm., or both, normally give good control of *Stenecotarsonemus* (*Tarsonemus*) *pallidus* (Banks) in older plantings of strawberry, but not in the commercially important second-year plantings, because of delay in entering them [*cf. R.A.E.*, A **42** 155, etc.]. Greenhouse and field experiments were therefore carried out in 1952–54 on the population trends of the pest and its predators, in an attempt to develop a practical control programme based on use of the latter. In the field tests, protection from predators in one plot of a pair and their introduction into the other showed that *Typhlodromus* afforded very marked control of *S. pallidus*. The introduction of 2–3 predators per plant in the autumn of the first year or the spring of the second gave complete economic control, the numbers of *S. pallidus* found per 30 leaflets on four different dates in 1953 and 1954 being 3,075 in the stocked plots and 69,630 in those kept free from *Typhlodromus*. The population trends indicated fairly regular and reciprocally dependent oscillations in numbers of predators and prey, with the latter reduced to economically unimportant levels. *Typhlodromus* is therefore promising for use in biological control, and, in order to establish it soon after planting in a field, the introduction of both it and *S. pallidus* is suggested, so as to achieve equilibrium at low prey densities and thus obtain economic control. It is pointed out that although *Typhlodromus* is a specific predator of *S. pallidus* and is dependent on it for reproduction, it can survive on honeydew and other liquid foods when prey density is low. Under such conditions, the strawberry plant provides

maximum protection for *S. pallidus*, and this, with spatial factors, ensures that it will not be eliminated by the predator. The ecological significance of the findings is discussed at some length.

TURNEY (H. A.). **Some Effects of cracked Grain on the Reproduction of the Saw-toothed Grain Beetle.**—*J. Kans. ent. Soc.* **30** no. 1 pp. 6–8, 2 refs. Manhattan, Kans., 1957.

The following is based on the author's summary. Experiments were conducted to determine what effect the content of cracked grains might have on the reproduction of *Oryzaephilus surinamensis* (L.) in cereals. Six tests were carried out with rough rice as the food, and one with maize. As the proportion of cracked grains was increased, so the populations of *O. surinamensis* developing in 2–3 months increased. A still greater production of progeny was obtained when the moisture content as well as the proportion of cracked grains was increased. Little or no reproduction occurred in clean rough rice with a moisture content of 12 per cent. or below. When *O. surinamensis* was confined with *Calandra* (*Sitophilus*) *oryzae* (L.) in whole grain, an increase in progeny was obtained with increasing proportions of *C. oryzae*, except when the ratio of the latter to *O. surinamensis* in maize was raised to 2:1.

GIBSON (W. W.). **Observations on the Wheat Curl Mite, *Aceria tulipae* (K.), (Acarina, Eriophyidae) on Wheat and Sorghum sprouted under ripening Wheat.**—*J. Kans. ent. Soc.* **30** no. 1 pp. 25–28, 3 refs. Manhattan, Kans., 1957.

The following is virtually the author's summary. In an experiment in Kansas, wheat and sorghum were planted at about the time of the wheat harvest under artificially lodged wheat and in stubble, in a field heavily infested with *Aceria tulipae* (Keifer). Periodic counts on the resulting seedlings showed that large numbers of Eriophyid mites left the surrounding ripening grain and infested the seedlings, both under lodged and stubble conditions. Mites were observed on the newly emerged seedlings only as long as they were present on the standing grain. Mite movement apparently ceased abruptly when the last heads ripened. Mites were found on sorghum seedlings for up to 26 days after emergence. Eggs were present on only four of 32 infested sorghum plants examined, all of which were in the two-leaf stage, suggesting that this host may not favour continuous mite reproduction in the field. The fact that seedling plants emerged earlier and grew better under lodged wheat as a result of more favourable moisture conditions may partially account for the more frequent occurrence of mites on volunteer wheat that emerges through a heavy layer of wheat straw.

MUMA (M. H.). **Effects of larval Nutrition on the Life Cycle, Size, Coloration, and Longevity of *Chrysopa lateralis* Guer.**—*Florida Ent.* **40** no. 1 pp. 5–9, 8 refs. Gainesville, Fla., 1957.

The following is based on the author's summary. The length of the life-cycle of *Chrysopa lateralis* (Guér.) was determined in the laboratory at 80°F., the food supplied for the larvae consisting of *Eotetranychus sexmaculatus* (Ril.), *Chrysomphalus ficus* Ashm. (*aonidum*, auct.), *Lepidosaphes beckii* (Newm.), *Dialeurodes citrifolii* (Morg.), *Panonychus* (*Metatetranychus*) *citri* (McG.) and eggs of their own species. The variation thus obtained (30–52 days) was found to approximate the previously published range for the genus.

Variations in adult size, coloration and length of life accompanied variations in the life-cycle. These are believed to be due to nutritional inadequacies rather than to mechanical starvation and to be a reflection of the host specificity of the insect.

Deane (B. C.) & Morrison (F. O.). **The Distribution and Importance of the Clover Root Borer** (*Hylastinus obscurus* (**Marsh**) **Coleoptera: Scolytidae**) **in Quebec.**—*Canad. J. Pl. Sci.* **37** no. 1 pp. 26–33, 9 refs. Ottawa, 1957.

Studies on the bionomics and possible importance of *Hylastes* (*Hylastinus*) *obscurus* (Marsham) in reducing the productivity of red clover (*Trifolium pratense*) in Quebec were made during 1953 and 1954. Sampling showed that the Scolytid occurred throughout the western, central and southern parts of the Province, and it was inferred from the results that eggs were present between 1st May and 25th July, larvae between 15th June and 15th September, pupae between 25th July and 5th November, and adults from 10th August to 10th July of the following year. In first- and second-year crops in which plant samples were taken weekly from 15th May till 11th September 1954, infestation was low and about equal in spring, but it increased between June and August from about 13 to about 29 per cent. in the first-year crop and from about 28 to 94 per cent. in the second-year crop. Very few adults were found on the plants in spring prior to the short dispersal period, which occurred in the first fortnight in May but was largely confined to one day, and the numbers were low even in fields where root infestation had been high in the previous autumn. A Cantharid larva, unidentified Dipterous larvae and an adult Staphylinid determined as *Gyrohypnus* sp. near *G. hamatus* (Say) were found feeding on the larvae. Attack by both *H. obscurus* and root rots was commoner on large plants than on small. In laboratory tests, 14 of 20 potted clover plants on each of which an adult that had been exposed to cultures of the causal organism of crown and stem rot (*Sclerotinia trifolium*) was confined, and six of a similar number on which adults exposed to cultures of the causal organism of northern anthracnose (*Kabatiella caulivora*) were confined, later developed disease symptoms and the organisms were subsequently cultured from them [*cf. R.A.E.*, A **44** 114]. Of 720 living roots taken in spring from a crop in which infestation had reached 20 per cent. in the previous autumn, only eight were infested, and winter mortality among infested roots at this stage is evidently high. A wettable-powder spray affording 1·5 lb. γ BHC per acre, applied in May to uninfested plants in small experimental plots that were artificially infested two days later with adults at the rate of two per plant, significantly increased the yield of green fodder [*cf.* **38** 431].

Bond (E. J.). **The Effect of Methyl Bromide on the Respiration of the Cadelle** *Tenebroides mauritanicus* (**L.**) (**Coleoptera: Ostomidae**).—*Canad. J. Zool.* **34** no. 5 pp. 405–415, 3 graphs, 24 refs. Ottawa, 1956.

The susceptibility of an insect to a fumigant is believed to be correlated with its rate of respiration. The effect of various physical factors on the latter is known [*cf. R.A.E.*, A **20** 696], but not that of the fumigant itself. Experiments were therefore carried out in which fourth-instar larvae and young unmated adults of *Tenebroides mauritanicus* (L.) reared in the laboratory [*cf.* **44** 224] were exposed for five hours to methyl bromide at 25°C. [77°F.] and 70 per cent. relative humidity in a respirometer. The larvae were exposed to the LD50 and the maximum sublethal dose (16 and

10 mg. per litre, respectively) and both larvae and adults to the LD99 (23 mg. per litre). The following is largely based on the author's summary of the results. The respiratory rate in individual insects varied considerably, and insects characterised by a high normal rate were more likely to succumb to the LD50 than those with a low one. The respiratory rate remained unchanged during the five-hour exposure, while the insects showed the complete succession of symptoms from hyperactivity to paralysis. Subsequently, there was a gradual decrease in respiration until death. Pre-treatment of the insects with a sublethal dose did not increase their resistance to lethal doses, thus demonstrating that protective stupefaction [*cf.* **42** 40, etc.] does not occur in *T. mauritanicus*.

Greenbank (D. O.). **The Role of Climate and Dispersal in the Initiation of Outbreaks of the Spruce Budworm in New Brunswick. I. The Role of Climate.**—*Canad. J. Zool.* **34** no. 5 pp. 453–476, 4 figs., 29 refs. Ottawa, 1956.

This is the first of two papers on the relative importance of climate [*cf. R.A.E.*, A **39** 151] and dispersal in initiating outbreaks of *Choristoneura fumiferana* (Clem.) on balsam fir [*Abies balsamea*] in New Brunswick, and is devoted to a consideration of climatic factors in relation to the outbreaks that began in 1912 and 1949. The following is largely based on the author's summary. Studies on a natural population in north-western New Brunswick in 1950–55 showed that larval development was more rapid in dry and sunny weather, which is associated with polar air masses, than in humid and cloudy weather, associated with tropical air masses and cyclones [*cf.* **38** 4; **40** 380]. An analysis, in conjunction with weather maps, of precipitation and temperature records for the month of June in the years 1887–1916 and 1924–1953 showed that climatic changes took place in regions in which the outbreaks developed. The outbreaks were preceded by dry and sunny summers during 4–5 consecutive years [*cf.* **44** 113], and favourable climatic conditions may have indirectly promoted population increase from the endemic to the outbreak level. Balsam fir normally flowers every second year in this area, but during a succession of dry summers, moderate flowering may occur after a year of heavy flower production; flowers were produced in four of the five years 1944–48. Larvae that feed on staminate flowers develop more rapidly than those that feed on foliage [*cf.* **40** 303], and observations in 1955 showed a significant difference in the fecundity of females that developed from pupae collected early and late in the season, even though all fed in the larval stage on foliage of the current season [*cf.* **43** 264]. The development of the larvae is not synchronised with shoot development on the tree. Shoot growth began late in 1945–48, whereas the weather favoured early emergence of the overwintered larvae. Under such conditions, the larvae mine in staminate flowers when these are available, and this also results in increased average fecundity. Increased fecundity cannot cause the development of an outbreak, however, unless natural mortality is reduced. Larval mortality does not appear to be much affected by weather, but data obtained for the construction of life tables for *C. fumiferana* [**44** 159] showed a tendency for it to increase in years in which development was prolonged, though the difference was not statistically significant. In the current outbreak, the initial increases in population occurred in both immature and mature stands, but the subsequent ones were greater in the latter, owing to the presence of flowers. The earlier appearance of serious defoliation in mature stands has led to the assumption that outbreaks originate in them [*cf.* **36** 207], though this is not necessarily the case.

Lyons (L. A.). **Insects affecting Seed Production in Red Pine. II.** *Dioryctria disclusa* **Heinrich,** *D. abietella* **(D. and S.), and** *D. cambiicola* **(Dyar) (Lepidoptera: Phycitidae).**—*Canad. Ent.* **89** no. 2 pp. 70–79, 3 figs., 17 refs. Ottawa, 1957.

This second part of a series on insects that reduce the seed production of red pine [*Pinus resinosa*] in Ontario [*cf. R.A.E.*, A **46** 129] contains information, based on observations in 1950–54, on the bionomics of *Dioryctria disclusa* Heinr., *D. abietella* (Schiff.), and *D. cambiicola* (Dyar), which together are second in importance to *Conophthorus resinosae* Hopk. [*cf. loc. cit.*], with descriptions of all stages of the first two species and of all but the egg of the third.

All three were most numerous in southern Ontario. *D. disclusa* is confined to eastern North America, where it occurs as far west as Iowa and as far south as North Carolina, and it attacks the second-year cones of red pine and jack pine [*P. banksiana*]. There is one generation a year. The first-instar larvae overwintered under flat hibernacula spun beneath the bark scales of red-pine branches and were observed boring in immature staminate flowers in late May. They reached the third or fourth instar during the first part of June, at about the time the pollen is shed, and then migrated to the cones, which they usually entered near the petiole. The larva excavates the seed-bearing region and usually severs the axis, as a result of which the cone soon withers; some infested cones are occasionally able to produce seed. Each larva probably attacks two cones. The larva becomes fully fed in July and pupates within a cocoon in the cone. In the field, pupae were found only in damaged cones, but some may occur elsewhere, since in the laboratory many larvae left the cones before pupating. The pupal stage lasted 5–21 days in 1953, and the adults emerged during the last half of July. Caged males and females survived for about nine and 12 days, respectively, and the females oviposited on branches of red pine suspended in the cages. Most laid 10–55 eggs each, though a few laid over 100. Like the overwintering larvae, which appeared not to have fed, the eggs occurred under bark scales on the needle-less parts (6–9 years old) of the branches. Natural control was due chiefly to parasitism in the pupal stage; 32 of 66 pupae collected in 1953 were parasitised and eight contained dead adults of *D. disclusa*. A species of *Ichneumon* (*Coelichneumon*), the larvae of which overwintered in the pupal case of the host and gave rise to adults in late spring, was responsible for 85 per cent. of the parasitism, and *Dibrachys cavus* (Wlk.), of which as many as 24 may develop in a single host, for the rest. Parasites reared from the larvae comprised *Microtypus* sp., *Ephialtes* (*Callicphialtes*) *comstockii* Cress., *Bracon rhyacioniae* (Mues.), and an undescribed Tachinid, which also attacked *Dioryctria abietella* and *D. cambiicola*.

*D. abietella* infests the cones, shoots and bark of many conifers [*cf.* **32** 2] and caused considerable loss of red-pine seed in Ontario in 1954, though it was of little importance in the other years. It has one generation a year, and the larvae were active throughout the summer, all five instars sometimes being present in July. Larvae that matured during July–August gave rise to adults in late summer, and their progeny probably overwintered as young larvae. Of those that matured in September, some gave rise to adults in the same year and others overwintered as pupae or prepupae in thin, débris-coated cocoons and gave rise to adults in the following spring. This species damaged the cones between early July and early September. The young larvae fed principally in cones damaged by other insects, but the older ones attacked undamaged cones, entering them near the petiole. Third- and fourth-instar larvae tunnel through the young seeds close to the axis, but fifth-instar individuals remain near the surface and feed on the scale tips.

As many as ten larvae may be present in one cone. Mature larvae migrated readily from one cone to another and in the laboratory usually left the cones before pupating. Females in glass jars laid a few eggs on second-year cones, depositing them singly between the scales. In 1954, the only observed mortality was due to parasitism, and *Elachertus* sp. was reared from the larvae as well as the Tachinid.

*D. cambiicola*, which was scarce, infested the shoots as well as the second-year cones of red pine near Lake Simcoe. The larvae and adults were present at about the same time as those of *D. disclusa*, but the larvae fed primarily in the pith of large shoots of the current season and attacked the cones only when nearly mature. In 1953, cone damage occurred in late July, and adults emerged in late July and early August. The larvae were parasitised by *Hyssopus rhyacioniae* Gah., in addition to the Tachinid.

Jacobson (L. A.) & Blakeley (P. E.). **A Method of rearing the Pale Western Cutworm, *Agrotis orthogonia* Morr. (Lepidoptera: Phalaenidae), in the Laboratory.**—*Canad. Ent.* **89** no. 2 pp. 87–89, 2 figs., 6 refs. Ottawa, 1957.

In the method described, up to ten pairs of adults of *Agrotis orthogonia* Morr. are confined in a glass jar, 6 ins. in diameter and 8 ins. in height, containing a ½-in. layer of sifted soil and fitted with a window-screen cover. A 10 per cent. honey solution is provided as food in a vial standing on the soil, and a piece of ¼-in. galvanised-wire screening propped against the vial gives access to it. Egg-laying begins within 2–3 days and continues for about ten days. The soil is sifted daily and the eggs transferred to small shell vials, in which they are incubated for 14–17 days at about 70°F. or 11 days at 30°C. [86°F.], after which they are stored at 0°C. [32°F.] and 50 per cent. relative humidity. When larvae are required, the eggs are placed on moist blotting paper and, on hatching, the larvae are transferred to petri dishes (15 × 60 mm.), in which they are reared in batches of ten or more during the first three instars and subsequently in isolation. They are fed on wheat sprouts [*cf. R.A.E.*, A **42** 169], and a convenient method of growing these is described; the sprouts are ready for use after five days, when about 1½ ins. long. One sprout is sufficient for several larvae up to the fourth instar and, at room temperatures, fresh ones are required every other day. At higher temperatures or if larvae of uniform size are required, sprouts must be provided daily. When the larvae cease feeding, they are transferred singly to clean containers, in which they pupate and the adults emerge. Larval and pupal development occupies 75–90 days at room temperature and less at constant temperatures of 25°C. [77°F.] or 30°C. The minimum number of larvae that will ensure sufficient moths to carry over from one generation to the next is about 500, and this number requires about four hours' attention per day.

Backs (R. H.). **Note on Effect of Flooding on the Carrot Rust Fly in the Holland Marsh Area of Ontario.**—*Canad. Ent.* **89** no. 2 pp. 89–90, 2 refs. Ottawa, 1957.

In October 1954, an extensive area of marshland in southern Ontario, parts of which are under cultivation, was flooded to an average depth of about 4 ft., and some sections were covered with over 10 ft. of water and remained flooded for 2–3 weeks. Early and late carrots in Ontario are attacked, respectively, by first- and second-generation larvae of *Psila rosae* (F.), and second-generation larvae were present at the time of flooding.

Population studies on this Psilid had been carried out in 1951–54 and were continued in 1955 to determine the effects of flooding. Numbers were estimated from records of adult emergence in cages, frequent counts of adults, larvae and puparia in fields of early and late carrots, and examinations of samples of carrots and soil for larvae and puparia, respectively. It was found that all the larvae and most of the pupae in the flooded area had been killed, though adults emerged from 12 of 41 puparia from a marginal area that was flooded for only one day; the mean percentage of emergence during the previous four years was 54·6. The number of adults captured in 1955 by sweeping represented only 11·5 per cent. of the average for the previous four years; these adults were probably derived from puparia in marginal areas or neighbouring uplands. Despite their presence, no larvae or puparia were found in either early or late carrots throughout 1955, for which the prevailing hot, dry weather and the extensive use of insecticides may have been partly responsible.

Stephens (J. M.). **Spore Coverage and Persistence of *Bacillus cereus* Frankland and Frankland sprayed on Apple Trees against the Codling Moth.**—*Canad. Ent.* **89** no. 2 pp. 94–96, 3 refs. Ottawa, 1957.

Sprays containing spores of *Bacillus cereus* were tested for the control of *Cydia* (*Carpocapsa*) *pomonella* (L.) [*cf. R.A.E.*, A **40** 303] on apple in British Columbia in 1954, when infestation was expected to be heavy. The spore concentrate was prepared from a culture of which the virulence had been increased 50-fold by passages through overwintering larvae [*cf.* **40** 304], and the spray, which contained about 70 million spores per ml., was applied to the trees six times between 26th May and 29th June and five times between 5th August and 8th September. After the first application, the mean deposit of spores per leaf amounted to about 25 million, but varied considerably, and this variation in coverage, and also a variation in persistence that could not be correlated with rainfall or interval between applications, was observed throughout the experiment. After later applications, the mean deposit became progressively higher than the theoretical maximum, and some germination of spores and multiplication of vegetative rods evidently took place. During the flight period of *C. pomonella*, the average deposit of spores and rods on the leaves was estimated at 27,000 per sq. mm., and a similar concentration presumably occurred on the fruits. The number of bacteria (about five spores per leaf) present on the trees before spraying rose slightly on unsprayed trees during the experiment, presumably owing to wind drift from the sprayed ones. The percentage infestation of the fruits on the sprayed trees and others that received no treatment of any kind was 53·7 and 48·2, respectively, and of 74 overwintered larvae collected from the sprayed trees in the following spring, only nine died as a result of infection. Since the larvae travel only a short distance before entering the fruits, a lethal dose of spores must be ingested at the point of entry. A spore concentration higher than the one used is not economically practicable, and this method of control in consequence shows no promise.

Silva (P.). **Problemas entomológicos do cacaueiro com referência especial à Bahia.** [Entomological Problems of Cacao, with special Reference to Bahia.]—*VI Reun. Com. téc. interamer. Cacau 1956* pp. 59–72, 22 refs. Bahia, 1957. (With a Summary in English.)

This paper consists of two parts. The first is a brief review of the insect pests of cacao throughout the world, and the second a survey of those that

attack the tree in the Brazilian State of Bahia; the latter is preceded by a list of the pests and associated insects, including natural enemies, arranged according to the plant parts concerned. The main pests in Bahia are ants, including *Azteca paraensis* var. *bondari* Borgm., against which latter a control campaign is in operation [*cf. R.A.E.*, A **35** 142], BHC being applied to its nests in the trees, *Monalonion bahiense* Costa Lima and *M. bondari* Costa Lima [*cf.* **27** 566], *Nodonota theobromae* Bryant [**12** 149], *Selenothrips rubrocinctus* (Giard), and *Planococcus citri* (Risso). Larvae of *Peosina mexicana* (Gn.) are injurious to the leaves in some years.

VAN DINTHER (J. B. M.). *Pseudaulacaspis pentagona* **Targ. as a Papaya Pest.**—*Ent. Ber.* **17** no. 9 pp. 165–168, 2 figs. Amsterdam, 1957.

*Pseudaulacaspis pentagona* (Targ.), all stages of which are described, is an important pest of papaya in Dutch Guiana, especially of young trees up to about a year old, which it sometimes kills. Investigations on its bionomics showed that the females lay 80–120 eggs each, over about a fortnight. The crawlers hatch in five days, and fix themselves on the stems and sometimes on the stalks or veins of the leaves or on the fruits. The life-cycle is completed in 45–50 days, so that there may be seven generations a year. The Coccid is attacked by several predacious insects, mainly Coccinellids, a list of which is given, and is sometimes completely eliminated from the trees by the larvae of *Pentilia castanea* Muls.

VAN EYNDHOVEN (G. L.). **L'interprétation de** *Bryobia speciosa* **Berl. (non Koch). Notulae ad Tetranychidas 4.**—*Ent. Ber.* **17** no. 3 pp. 43–44. Amsterdam, 1957. **Le** *Bryobia cristata* **de Dugès. Notulae ad Tetranychidas 5.**—*T. c.* no. 9 pp. 171–183, 45 figs., 11 refs.

In the first of these two parts of a series [*cf. R.A.E.*, A **45** 86], the author proposes the name *Bryobia berlesci* for *B. speciosa* Koch as misidentified by Berlese. In the second, he quotes Dugès' description of *Bryobia cristata* [*cf. loc. cit.*] and describes all stages of this mite, including the males, from examples found sheltering beneath the bark of trees in and near Paris in the autumn of 1955. It feeds on grasses and other low-growing plants round the trees and has several generations a year. Mites found on plum near Montpellier were tentatively identified as *B. rubrioculus* (Scheuten).

DJOJOPRANOTO (A.). *Guisardus guttatus* **nov. spec.**—*Idea* **10** no. 4 pp. 13–16, 3 figs., 2 refs. Djakarta, 1957.

DJOJOPRANOTO (A.) & SASTROSADARPO (S.). **Biologi dan memberantas hama malindjo (*Gnetum gnemon* Linn.) dengan obat H.C.H.** [Bionomics of the *Gnetum gnemon* Pest and its Control with BHC.]—*Tehnik Pertanian* **6** no. 5 pp. 153–192, 22 figs., 3 graphs, 5 refs. Bogor, 1957. (With a Summary in English.)

It is stated in both these papers that *Gnetum gnemon*, a tree of some economic importance of which the young leaves, blossoms and fruits are used as vegetables in Indonesia, suffered considerably in West Java in September 1956 from an outbreak of a Mirid. This is described from the adult in the first paper (which is in English) as *Guisardus guttatus*, sp. n., and observations on its bionomics and control are recorded in the second. Insectary observations at an average temperature of 26°C. [78·8°F.] from

September 1956 to February 1957 showed that two generations developed in 50 days, giving a theoretical total of 15 in the year. The eggs were laid in batches of 4–8, or sometimes singly, in the axils of the leaves and blossoms, after a preoviposition period of 3–5 days. The average number per female was nine, with limits of 3–30. The egg and nymphal stages averaged 6 and 10 days, respectively, and feeding on the leaves caused them to dry up. Two unidentified Hymenopterous parasites were reared from the eggs. BHC proved more effective against the bug than derris or parathion in laboratory spray tests, and a spray of 0·1 per cent. BHC proved effective in the field. It should be applied in February, June and October, preferably in the morning.

Kalshoven (L. G. E.). **Further Observations on the Dispersal and Settling of *Neotermes* Alates in Teak Forests in Java.**—*Idea* **10** no. 4 pp. 7–12, 1 ref. Djakarta, 1957.

Observations on the behaviour of the alates of *Neotermes tectonae* (Damm.) in founding colonies in teak trees in Java [*cf. R.A.E.*, A **18** 286] were continued in 1933–36. They indicated that dead girdled trees left standing in the forest were not as attractive as rotten branches in the crowns of living trees, and so would be of no value as traps, that the alates from older stands move above the canopy of young plantations, and so cannot be prevented from settling in any part that has reached the age at which the trees become susceptible to infestation, and that the alates are not dependent on the presence of holes to enter rotten wood, though they use these if present, being able themselves to bite holes in places where the wood is soft.

Masaki (S.). **On the pupal Diapause of *Pieris rapae* Linné (Lepidoptera: Pieridae), with special Reference to the Effect of Temperature on its Elimination.**—*Jap. J. appl. Zool.* **20** no. 1–2 pp. 98–104, 4 graphs, 11 refs. Tokyo, 1955.

*Pieris rapae* (L.), one of the most important pests of cultivated crucifers in Japan, passes through several generations in Sapporo between mid-April, when the first adults appear, and October, when most of the pupae enter diapause and hibernate.

Investigations on the factors inducing diapause and the effect of temperature in eliminating it were begun in November 1953, when pupae collected in the field in October were exposed to a temperature of 5°C. [41°F.] for periods of 10–65 days and then transferred to 26°C. [78·8°F.] and kept under observation for two months. Diapause was considered to have been eliminated if adults emerged about a week after transference to the higher temperature, as this gave a pupal period equal to that of non-diapausing pupae, and this occurred in all pupae subjected to the low temperature for 65 days and to some 15, 40, 80 and 90 per cent. of those exposed to it for 10, 25, 40 and 55 days, respectively, but in only 5 per cent. of control insects kept at 26°C. throughout the experiment; about 40 per cent. of these and 20 per cent. of those exposed to 5°C. for ten days were still in diapause at the end of the experiment, but the numbers were gradually reduced with increasing exposure and reached zero at 55 days. The diapause of pupae that transformed to adults 20–52 days after being transferred to the higher temperature is considered to have been weakened, and the percentage of pupae in this condition fell from 60 after ten days of exposure to 0 after 55. Pupae that were not exposed to cold gave rise to adults throughout the experimental period, showing that there was great variation in the intensity of diapause among the population.

When pupae were kept at −2 to 12°C. [28·4 to 53·6°F.] for 55 days and then transferred to 26°C., diapause appeared to have been eliminated, as all adults emerged after about a week at the higher temperature; the low temperatures had no adverse effects on the pupae. When pupae were kept continuously at 19°C. [66·2°F.] or 26°C., emergence was fairly evenly distributed over a long period, indicating that the temperatures were unfavourable for terminating diapause. Post-diapause development seemed to take place at 12°C., as pigmentation of the adult cuticle below the pupal skin was observed and adults began to emerge three days after transference to the higher temperature, but it seemed to be prevented at 5°C. or less, emergence beginning only after 6–8 days at 26°C.

When pupae in which diapause had been eliminated by prolonged exposure to 5°C. were transferred to temperatures of 12, 19, 26 and 30°C. [86°F.], they gave rise to adults in averages of 52·8, 13·9, 7·8 and 6·3 days, respectively, indicating a threshold of development of about 8°C. [46·4°F.]. It appears, therefore, that pupae may require a low temperature to complete diapause and then a high one to develop rapidly. The pupae varied in colour from light brown to green, but no relation could be found between colour and elimination of diapause.

To determine the effect of photoperiod in the larval stage in inducing diapause in the pupae, larvae from eggs collected in August 1953 were fed on cabbage at 22–26°C. [71·6–78·8F.], and kept under artificial light for 10 or 16 hours a day. Pupae from both batches were transferred to 26°C. within a day after pupation, and the emergence records showed that none of 15 that had been exposed to light for 16 hours a day entered diapause, whereas 10 of 16 exposed for ten hours did so. It appears, therefore, that diapause may be brought about by a short photoperiod and prevented by a long one.

Koula (V.) & Důrasová-Janů (M.). **Aerosoly v boji proti mandelince bramborové** (*Leptinotarsa decemlineata* **Say**). [Aerosols for the Control of *L. decemlineata*.]—*Sborn. čsl. Akad. zeměd. Věd.* Rostl. Výroba **3** (**30**) no. 1 pp. 87–100, 6 figs., 15 refs. Prague, 1957. (With Summaries in Russian, English & German.)

Large-scale field experiments were carried out in Czechoslovakia in 1955 on the effectiveness of a DDT aerosol applied by aircraft against *Leptinotarsa decemlineata* (Say) on potato. The aerosol was released from a 10 per cent. solution of DDT applied at about 0·54 gal. per acre, and complete mortality was obtained, in spite of the reported ineffectiveness of DDT against *L. decemlineata*. Because of the danger to beneficial insects, such indiscriminate treatment of large areas is not recommended. Hand equipment is sufficient for treatment of small plots, and ground machinery for fields.

Papers noticed by Title only.

May (A. W. S.). **Queensland Host Records for the Dacinae (fam. Trypetidae). First supplementary Lists.**—*Qd J. agric. Sci.* **14** no. 1 pp. 29–39, 3 figs., 2 refs. Brisbane, 1957. [*Cf. R.A.E.*, A **42** 344.]

Bakke (A.). *Eucosma* [*Enarmonia*] *ratzeburgiana* (**Ratz.**) (**Lep., Tortr.**) **injurious to Spruce Flowers in Norway.**—*Norsk ent. Tidsskr.* **10** pt. 2–3 pp. 91–94, 1 fig. Oslo, 1957.

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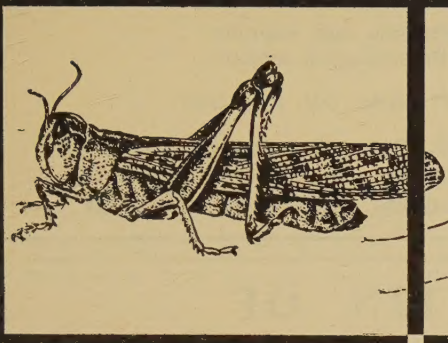

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